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FUNDAMENTAL GRASSLAND RESEARCH.

SCHEME OF EXPERIMENTATION INITIATED BY DEPARTMENT OF AGRICULTURE.

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GRASSLAND research work up to the present has led to the conclusion that the constitution of the sward is governed almost entirely by the environmental conditions under which the pasture plants are asked to grow, and that the successful grassing of any country is a question of either (1) choosing species attuned to conditions as they exist or come to exist on any one soil-type, or (2) modifying conditions by draining, liming, manuring, harrowing, &c., so that the higher-production species may thrive.

We may start, then, with the conception that each grass and each clover has a standard set of conditions which must be provided before that species will persist and thrive. Each species is an indicator of the environmental conditions ruling, and when undesirable change in the composition of our pastures takes place the task before the farmer is the reconditioning of his soil-types so that the high-production, palatable grasses and clovers may be provided with the essential conditions that make it possible for them to persist and thrive.

Bulk of herbage and tallness of growth are the two major factors that operate to dominance of any one species or set of species. Those species possessing the inherent capability of high production will always dominate other species of limited production, provided always that the wherewithal is provided for the high producer to produce its maximum. Rye-grass has the inherent capabilities for high production, whereas a grass like danthonia is not capable of high tonnage per acre; brown-top has a capacity to produce higher than danthonia, but lower than rye-grass. Hence so long as the necessary conditions are provided for rye-grass to produce its maximum, danthonia or brown-top will be powerless to compete successfully against it; but allow the conditions to alter and to become unsuited for rye-grass, so that its yield rapidly diminishes, then brown-top will beat rye-grass in production and will be placed in a position of successfully competing against it. The same may be said of danthonia.

Tallness of growth is a very deciding factor also affecting the constitution of a mixed grassland association. Rye-grass under moderate

grazing will beat cocksfoot in production, but under light grazing the cocksfoot gets away on strong land and overtops the rye-grass, literally smothering it out by its taller, but not necessarily denser, growth.

The conditions for rye-grass dominance are different from those that favour cocksfoot dominance. Actually the rise to cocksfoot dominance indicates a weakness in pasture utilization, and, while the value of cocksfoot is fully recognized, yet it is quite unwise to endeavour to create the exact conditions for cocksfoot, else rank, non-milk-producing feed will predominate. The same may be said of red clover. To create ideal grazing conditions for red clover the pasture must be allowed to grow too rank for maximum milk-production. Maximum milk-production centres about that pasture that can be kept moderately short, ever producing young leaf, and dense in the bottom. Tallness of growth is no criterion of high milk-production—rather the reverse. The ideal growth, to my mind, is best attained in the perennial rye-grass and white clover dominant pasture. The conditioning of our grassland soil-types to the rye-grass and white clover dominant ideal is the task before every farmer—on arable land at least. We make rye-grass and white clover dominant the ideal, for then we know (1) that the physical conditions of the soil are perfect for high production—not too dry nor yet too wet; (2) that the soil-fertility upkeep is right; (3) that the utilization of the pasture herbage is correct; and (4) that the food consumed is of a high nutritive content—perfect for milk-production, whether by the dairy cow or the ewe.

Certain soils, then, it will be necessary to drain, for rye-grass cannot stand "wet feet" in the winter; most soils will have to be limed; all soils will have to be liberally supplied with phosphates, and later on most likely with a complete manure containing potash and nitrogen in addition to the phosphates and lime. The point I wish to make is that the rye-grass and white clover ideal is possible under nearly all grassland conditions in New Zealand, and that maximum production will not be secured until such ideal is attained. The pasture need not necessarily be limited only to these two species—crested dogstail, timothy, cocksfoot, paspalum, and other first-class high-production species should be included—but the management should be such that for the greater period of the year rye-grass and white clover are dominant.

At the present time the Department of Agriculture is initiating experiments on all leading soil-types to determine under ordinary grazing just what are the conditions necessary on each type for the attainment of rye-grass and white clover dominance. In the *Journal* for June, 1925, in an article presenting a preliminary ecological classification of grassland species, it was shown that the common grasses and clovers could be grouped, and that each had a more or less definite habitat range.

A second aspect fundamental to grassland improvement is the testing of strains of the different species. Just as species have been moulded to suit a particular set of environmental conditions, so too may there be variation in adaptability within the species itself; and centred in the consideration of strain lies the fundamental conception of the possibilities of widening the habitat range of each species. Can

we by strain-selection widen the habitat range of rye-grass, cocksfoot, white clover, &c. ?

A further aspect in regard to strain, apart from the widening of the habitat range, is the nature of the herbage produced. Certain strains of rye-grass, cocksfoot, &c., may develop more towards leaf than towards stalk and seed, and the former characteristic from a grazing point of view must be greatly superior.

As with stock so with pasture-plants it is possible to feed poor strains, and it is going to be harder to secure our ideal unless greater attention is paid to the question of strain. For my part, I do not agree that it is wise to choose or to breed plants to suit impoverished conditions in our grassland soil-types. Rather do I claim that it is better to choose high-yielding species or strains of grasses and clovers, and to provide those with the conditions necessary for their persistence and growth. Permanent high production, in my opinion, is not possible on poor soils, and if we wish to grass our poor soils with strains of rye-grass and white clover—if this is possible—such strains must of necessity be low-producing strains.

For general permanent pastures (in the North Island, at least) the general opinion is that Hawke's Bay rye-grass is superior to Canterbury rye-grass. Canterbury rye-grass is very prolific for a start, but then it is very inclined to weaken and open up in the bottom ; whereas Hawke's Bay rye-grass is somewhat shorter in growth, denser in the bottom, and more persistent under the average pasture conditions existing to-day. But are these conditions the optimum conditions for Canterbury rye-grass ? Will it continue to produce if it is more highly fed ? In other words, is Canterbury rye-grass bred up to a higher standard of production than Hawke's Bay rye-grass, and consequently demanding for its permanence better conditions than the latter ? A similar comparison may be made between Kentish wild white clover (which is harvested from extremely old pastures in Kent) and the New Zealand old-pasture white. Under optimum manuring the taller-growing, larger-leaved New Zealand white clover will probably easily beat the Kentish wild white in production ; but under a lower standard of soil-fertility upkeep the lower-producing Kentish will naturally be more persistent, because it is attuned by natural selection to a harder set of conditions. Here again our aim should be the conditioning of all land possible to high-production strains, rather than being content to see the ground covered by persistent but low-production strains.

Hand-in-hand with the work on conditioning soil-types to rye-grass and white clover dominance the testing of the different strains of the common grasses and clovers is being undertaken in one composite experiment. The scheme consists in laying down on each soil-type a series of plots in which perennial rye-grass and white clover figure as dominants in all sowings. In each plot, as far as the grasses are concerned, additional to the perennial rye-grass and white clover base, one other grass species or strain is included. In the case of the different clovers the base is perennial rye-grass, cocksfoot, crested dogstail, and white clover, and in each plot one other clover or strain of clover is added to the base. It is the intention to so manage and manure these plots that perennial rye-grass and white clover are maintained dominant,

and to study under such conditions which other species or strains persist and function best as subsidiary species in the sward.

Further, besides including all the first-class grasses and clovers and their commercial strains in the series, inferior grasses and clovers such as Yorkshire fog, brown-top, danthonia, rattail, Chewings fescue, suckling clover, clustered clover, &c., figure in the experiment. The objective here is to determine on each soil-type how much and what kind of manure to apply in order to manure out these inferior species. It is not claimed that on all soil-types it will be economically sound to manure out all inferior species; but it is well worth while spending time and money to determine just what quantity of manure and in what form it should be applied, in order to attain our objective and to determine actually what each £1 spent on manure does effect in directing the pasture towards the ideal here set down.

LOCATION OF PLOTS AND DETAILS OF SCHEME.

Last autumn experimental plots were laid down on the following soil-types at the places stated:—

(1) Central Development Farm, Weraroa: First-class country; heavy alluvial river deposit; fertile soil approaching the rye-grass and white clover standard.

(2) Marton Experimental Area, Marton: Heavy clay land; typical brown-top soil-type—that is, brown-top comes in as a volunteer, and becomes dominant unless the quality of the soil is improved by systematic top-dressing.

(3) Katere Experimental Area, New Plymouth: Light, friable soil which runs predominantly to sweet vernal and danthonia, with rosette weeds of the catsear, rib-grass type. Typical natural sweet vernal and danthonia soil-type.

(4) Waimate West Demonstration Farm, Manaia: Typical Taranaki coastal country; moderately light, friable, volcanic loam, its natural state of fertility bordering on the cocksfoot soil-type.

Each series of plots is laid down in triplicate or quadruplicate and arranged according to the accompanying plan (page 5).

At the beginning of each series pure sowings have been made of each species and strain used throughout the experiment, and in certain instances blank plots have been left for studying the volunteer growth that appears on each respective soil-type.

In the case of sowings where strain is involved, the lines of seed secured are in most cases blends of a number of lines all of the same origin. By this means a truer representative sample of any one particular strain is secured, and the chance of striking an exceptionally good or an exceptionally bad line of any one strain is very much reduced.

Each sowing is divided into four: first sector, no manure; second sector, all phosphate manure; third sector, no manure; fourth sector, phosphate plus nitrogen and potash.

The kinds and amounts of manure will vary according to the soil-type on which the experiment is laid down, and annual or twice-yearly applications will be made in order to keep rye-grass and white clover

Pure sowings of each species and strain included in base mixtures.	Series 1				Series 2				Series 3				Series 4			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
36					36					35					54	
37					37					34					53	
38					38					33					52	
39					39					32					51	
40					40					31					50	
41					41					30					49	
42					42					29					48	
43					43					28					47	
44					44					27					46	
45					45					26					45	
46					46					25					44	
47					47					24					43	
48					48					23					42	
49					49					22					41	
50					50					21					40	
51					51					20					39	
52					52					19					38	
53					53					18					37	
54					54					17					36	
1					1					16					35	
2					2					15					34	
3					3					14					33	
4					4					13					32	
5					5					12					31	
6					6					11					30	
7					7					10					29	
8					8					9					28	
9					9					8					27	
10					10					7					26	
11					11					6					25	
12					12					5					24	
13					13					4					23	
14					14					3					22	
15					15					2					21	
16					16					1					20	
17					17					54					19	
18					18					53					18	
19					19					52					17	
20					20					51					16	
21					21					50					15	
22					22					49					14	
23					23					48					13	
24					24					47					12	
25					25					46					11	
26					26					45					10	
27					27					44					9	
28					28					43					8	
29					29					42					7	
30					30					41					6	
31					31					40					5	
32					32					39					4	
33					33					38					3	
34					34					37					2	
35					35					36					1	

Details of Mixtures Sown in Plots of each Standard Area.

1. Base (a)* plus Western Wolths rye-grass, 10 lb.
2. Base (a) plus Italian rye-grass, 10 lb.
3. Hawke's Bay old pasture rye-grass (blend), 30 lb.; N.Z. white clover (blend), 2 lb.
4. Hawke's Bay maiden old pasture rye-grass (blend), 30 lb.; N.Z. white clover (blend), 2 lb.
5. Southland rye-grass (blend), 30 lb.; N.Z. white clover (blend), 2 lb.
6. Sandon rye-grass (blend), 30 lb.; N.Z. white clover (blend), 2 lb.
7. Canterbury rye-grass (blend), 30 lb.; N.Z. white clover (blend), 2 lb.
8. Base (a).
9. Base (a) plus timothy, 10 lb.
10. Base (a) plus prairie-grass, 40 lb.
11. Base (a) plus meadow-fescue, 20 lb.
12. Base (a) plus meadow-foxtail, 10 lb.
13. Base (a) plus *Poa trivialis*, 5 lb.
14. Base (a).
15. Base (a) plus Akaroa cocksfoot (blend), 15 lb.
16. Base (a) plus Danish cocksfoot (blend), 15 lb.
17. Base (a) plus Plains cocksfoot (blend), 15 lb.
18. Base (a).
19. Base (a) plus Sandon crested dogtail (blend), 6 lb.
20. Base (a) plus Southland crested dogtail (blend), 6 lb.
21. Base (a) plus *Poa pratensis*, 5 lb.
22. Base (a) plus Australian paspalum, 10 lb.
23. Base (a).
24. Base (a) plus Waipu brown-top (blend), 5 lb.
25. Base (a) plus Southern brown-top (blend), 5 lb.
26. Base (a).
27. Base (a) plus Chewings fescue, 10 lb.
28. Base (a) plus Hawke's Bay *Danthonia pilosa*, 10 lb.
29. Base (a) plus Canterbury *Danthonia pilosa*, 10 lb.
30. Base (a) plus *Danthonia semianularis*, 10 lb.
31. Base (a) plus ratstail, 2 lb.
32. Base (a) plus Yorkshire fog, 10 lb.
33. Base (a) plus red-top, 5 lb.
34. Base (b).†
35. Base (b) plus Marlborough red clover, 6 lb.
36. Base (b) plus Canterbury red clover, 6 lb.
37. Base (b) plus Wairarapa red clover, 6 lb.
38. Base (b) plus Montgomeryshire red clover, 6 lb.
39. Base (b) plus English trefoil, 4 lb.
40. Base (b).
41. Base (b) substituting volunteer Marlborough white clover, 2 lb.
42. Base (b) substituting Canterbury stubble white clover (blend), 2 lb.
43. Base (b) substituting old pasture N.Z. white clover (blend), 2 lb.
44. Base (b) substituting imported Polish white clover, 2 lb.
45. Base (b) substituting Kentish wild white clover, 2 lb.
46. Base (b).
47. Base (b) plus alsike, 4 lb.
48. Base (b) plus subterranean clover, 6 lb.
49. Base (b) plus Southland Lotus major, 2 lb.
50. Base (b) plus imported Lotus major, 2 lb.
51. Base (b) plus Lotus hispidus, 2 lb.
52. Base (b) plus suckling clover, 3 lb.
53. Base (b) plus clustered clover, 3 lb.
54. Base (b).

* Base (a): Canterbury perennial rye-grass (blend), 20 lb.; N.Z. white clover (blend), 2 lb.; total, 22 lb. per acre.

† Base (b): Canterbury perennial rye-grass (blend), 15 lb.; Akaroa cocksfoot (blend) 10 lb.; Southland crested dogtail (blend), 3 lb.; N.Z. white clover (blend), 2 lb.; total, 30 lb. per acre.

dominant on each soil-type. The object of this is to determine the amount of manure required to build up and maintain each soil-type to perennial rye-grass and white-clover standard, and to study the reaction of such a sward on the individual species sown with the base species.

An amount of 3 cwt. superphosphate and 4 cwt. carbonate of lime per acre was applied uniformly over the whole series of each area at time of sowing.

It is not intended to keep records of the weights of herbage produced, and the plots are to be kept grazed.

As many of the areas as possible will be subjected to exact botanical analysis, and the point-quadrat method will be employed for determination of change and recording exact constitution of the pasture sward.

AIMS IN BRIEF.

Concise expressed, the aim of the experiment is as follows :—

(1) Determination of fundamental ecological relation of each grassland species to soil-type under normal grazing-conditions and within a mixed association.

(2) Determination of fundamental ecological relation of "strain" and improved "breeds" of grassland species to soil-type under normal grazing-conditions and within a mixed association.

(3) Determination of succession from initial turf on each soil-type to natural climax under normal grazing-conditions, without top-dressing. In this it is expected to get a readjustment of species according to the natural fertility resources of the soil, and the ultimate climax will be a measure of the soil-type.

(4) Modification of soil-type so as to bring about or maintain conditions suitable for the persistence and thriving of high-yielding grassland species. Determination of amount, nature, and cost of manure to apply on each soil-type in order to bring this about.

(5) In addition there is the question of relationship of soil-moisture, light and shade, temperature, growth-form, relative palatability of the species, &c., under optimum grazing and optimum manuring.

CONCLUSION.

It appears evident that the two lines of research here outlined are really fundamental to grassland improvement. The conditioning of all the better soil-types at least towards the rye-grass and white-clover ideal may be regarded as the best immediate method of increasing production from the sown grasslands of New Zealand. For areas broken up for the first time, and those being relaid to permanent pasture, consideration of strain may add much to the wealth from grassland. We are probably far from maximum production, and even when the possibilities of our present species and strains are exhausted the way is open by plant-breeding to even higher production, provided always that equally improved conditions for plant-growth are created by the farmer. No choice of species, no consideration of strain, will in itself give permanent high production. It is only when coupled with conditions of the habitat under which the plants are asked to grow that sound improvement can be effected.

CERTIFICATION OF SEED POTATOES.

(Continued.)

INFORMATION GAINED FROM FIRST YEAR'S WORKING OF SYSTEM IN CANTERBURY.

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THE matter here appearing has been prepared with the object of drawing attention to certain observations made during the progress of the past season's operations in the certification of seed potatoes in Canterbury, and it is hoped they will prove beyond all doubt the imperative need of some system whereby growers may be guided in the selection of the seed they plant.

The present standard of our potato crops in regard to purity and disease is to some extent indicated in the accompanying tables, while the variation in cropping-power of lines within a variety is abundantly proved. It is to be remembered that the crops upon which these observations are made were those entered for certification. They do not, of course, represent all the best crops in Canterbury, but they are most likely above the average, otherwise they would hardly have been entered, and the trial plots at Ashburton were planted with hand-picked seed sent in by the individual growers.

CROPS ENTERED AND REJECTED.

Table I gives a summary of crops entered and rejected in the field. The remainder have been passed provisionally, but some of these are likely to be rejected during the final tuber-inspection which takes place when the seed is graded ready for sale.

Table I.—Summary of Crops entered and rejected in Field.

Variety.	Number of Lines entered.	Area entered.	Number of Lines rejected in Field.	Area rejected in Field.
		Acres.		Acres.
Dakota	28	286	16	165
Pink Beauty of Hebron ..	3	13	2	11
Early Rose	1	1	1	1
Robin Adair	4	7	1	1
White Beauty of Hebron	1	2	1	2
Early Puritan	2	..	2	..
Early Regent	1	35	..	..
British Queen	1	11	1	11
Bresee's Prolific	13	118	2	13
Aucklander Short-top ..	22	134	15	60
Aucklander Tall-top ..	8	43	3	13
Epicure	14	37	9	25
Arran Chief	23	127	19	91
Northern Star	1	35	..	..
Gamekeeper	1	5	1	5
Endurance	3	6	2	5
Up-to-Date	11	34	8	21
Total	137	894	83	424

A list of growers who have been issued provisional certificates was published in the May issue of the *Journal*.

ASHBURTON EXPERIMENTAL FARM TRIAL PLOTS.

Every grower applying for inspection was required to forward to the Ashburton Experimental Farm one hundred sets of seed-size potatoes taken from his particular line. In this way lines were collected from all parts of Canterbury, and were grown together on one area where they could be compared with one another. These plots served a very useful purpose. They were the source of much interest to the growers, assisted the inspectors in judging farm crops which—being grown on a wide range of soils—were of a most variable character, and, finally, served to present some information of great practical value.

Most of the seed was very carefully selected by the growers, and it is doubtful if last season an equal area in any part of New Zealand was planted with such apparently good-quality seed, yet some of it was quite worthless, as is indicated by the yields obtained.



FIG. 1. SHOWING DEFERRED GROWTH DUE TO CORTICIUM INFECTION.

Note the two retarded plants in front centre.

The plots were planted on 12th and 13th October, and two months later the normal plants were from 9 in. to 12 in. high. A count was made at this time to determine the proportion of subnormal plants—that is, those plants in which growth was very much retarded (Fig. 1). In almost every case this pronounced delay was due to corticium infection, and this disease would appear to exercise a very serious drain upon the vitality of the plant. So far, no very definite information is available as to the amount of loss corticium may occasion, but the figures in Table 2 indicate that the proportion of infection, accompanied by serious retardation of growth, averages for all varieties 18.8 per cent. This average is arrived at after inspecting 13,300 plants, and the range of infection in different lines varies from 5 per cent. to 44 per cent.



Row 14.
5'3 tons.

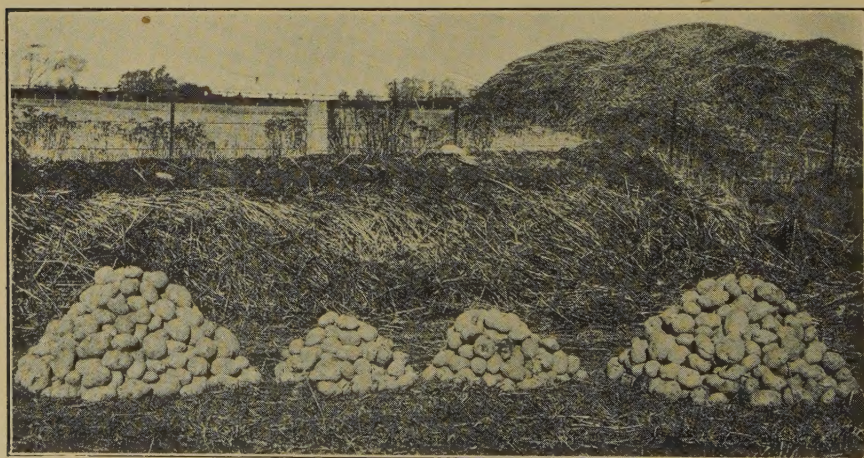
Row 13.
8'3 tons.

Row 12.
3'6 tons.

Row 11.
5'5 tons.

FIG. 2. SOME OF THE LINES OF DAKOTA UNDER TRIAL AT ASHBURTON EXPERIMENTAL FARM.

Figures given under different rows in photo refer to yield of table potatoes per acre. Note vigour and yield of row 13 compared with adjoining rows 11 and 12, both of which are carrying wilt-disease and early blight.



Row 13.
8'3 tons.

Row 19.
2 tons.

Row 21.
2'75 tons.

Row 31.
8 tons.

FIG. 3. ACTUAL YIELD OF TABLE TUBERS FROM THE TWO HIGHEST AND THE TWO LOWEST CERTIFICATION LINES OF DAKOTA TESTED AT ASHBURTON.

The figures refer to yields computed in tons per acre.

Table 2.—*Proportion of Deferred Growth due to Corticium Disease.*

Variety.	Number of Lines inspected.	Average Percentage of Infection and Retardation.	Variety.	Number of Lines inspected.	Average Percentage of Infection and Retardation.
Dakota	27	22.5	Bresee's Prolific ..	14	20.2
Pink Beauty of Hebron	3	9.3	Aucklander Short-top	22	16.7
Early Rose ..	1	8.0	Aucklander Tall-top	7	16.0
Robin Adair ..	4	20.0	Epicure	14	14.8
White Beauty of Hebron	1	19.0	Arran Chief	22	19.7
Early Regent ..	1	16.0	Northern Star ..	1	9.0
British Queen ..	1	24.0	Gamekeeper	1	14.0
			Endurance	3	19.3
			Up-to-Date	11	20.9

Total crops, 133. Average for all lines, 18.8 per cent.

SUMMARY OF REJECTED CROPS.

The first field inspection was carried out during January and early February, when the crops were in full flower. The second inspection was made during April, when the haulms were maturing and the tubers could be inspected. Table 3 summarizes the position, but it must be noted that the information is far from complete. The records were not made for the purpose to which they are now being put, and an inspector who might on examination find a high percentage of foreign varieties might record the percentage as evidence for rejection, and disregard the possibility of the crop being liable to rejection for other additional reasons.

Of the 138 crops entered ten were wrongly named, but as five of those sent in as Magnum Bonum were pure lines of Bresee's Prolific they were accepted as such. Three crops were withdrawn, and six were not eligible, being under the minimum area of 1 acre. By far the largest proportion of rejections was occasioned by the presence of foreign varieties, more especially in the Dakota and Arran Chief varieties. The second field inspection over all varieties disclosed that approximately 29.7 per cent. of the plants examined were infected with wilt disease, as indicated by vascular discoloration. This late infection does not appear to reduce the yield to any appreciable extent, and for the present is disregarded as a factor in certification. The early wilt infection observed during the first field inspection to an extent of 1.5 per cent. appears to be more serious, and was taken into consideration.

CROPPING POWER.

The ultimate aim of certification is to improve production by propagating from the best lines, and the question arises, is there any great variation in the yielding-powers of one line of seed as against another line of the same variety? To this it can be asserted definitely that a very great deal of variation does occur, and that, irrespective of the variety, lines of seed are bought and sold which are quite worthless, incapable of producing any return, and a menace to successful potato-growing.

Table 3.—Summary of Rejected Crops.

Variety.	Number of Crops entered and inspected in First Inspection.	Causes for Rejection on First Inspection.			Number of Crops passed in First Inspection and again inspected.	Causes for Rejection on Second Inspection.				Number of Crops passed in Second Inspection and issued Provisional Certificates.	
		Foreign Varieties.	Virus Diseases.	Early Wilt.		Foreign Varieties.	Earworm.	Virus Diseases.	Late Blight.		Powdery Scab.
Dakota ..	28	8	1	1	18	2	3	1	..	..	12
Pink Beauty of Hebron ..	3	1	..	1	1	..	..	..	..	..	1
Robin Adair ..	3	..	..	..	3	..	..	..	..	..	3
White Beauty of Hebron ..	1	..	1	..	..	..	..	..	..	..	..
Early Regent ..	1	..	..	..	1	..	..	..	..	..	1
British Queen ..	1	1	..	..	..	..	..	..	..	..	..
Bresee's Prolific ..	13	..	..	..	13	..	2	..	..	..	11
Aucklander Short-top ..	21	6	1	..	14	2	3	1	1	..	7
Aucklander Tall-top ..	8	1	1	1	5	..	..	..	..	..	5
Epicure ..	13	..	1	5	7	..	..	1	..	1	5
Arran Chief ..	21	16	..	..	5	..	1	..	..	..	4
Northern Star ..	1	..	..	..	1	..	..	..	..	..	1
Endurance ..	3	..	..	1	2	..	1	..	..	..	1
Up-to-Date ..	7	1	..	1	5	..	1	..	1	..	3
Totals ..	124	34	5	10	75	4	11	3	2	1	54



FIG. 4. THREE OF THE UP-TO-DATE LINES SENT IN FOR CERTIFICATION.

Centre row is badly affected with wilt-disease and early blight; row on right contains a number of "bolters." The figures under rows refer to yield of table potatoes per acre.



FIG. 5. BAGGED YIELDS OF TABLE POTATOES FROM RESPECTIVE ROWS SHOWN IN FIG. 4.

Most growers and merchants look upon certification as a helpful means of procuring varieties true to name, and, without detracting from this aspect of its value, the fact remains that the greatest benefit will be derived from the elimination of the unproductive and virus-infected lines. While there are no means by which the "scrub" crop may be condemned, this object is achieved indirectly through certification, by giving a stimulus to the distribution of the produce of healthy productive crops for seed purposes. So great is this variation that growers should pay as much attention to the origin of strain of the seed they intend to plant as they are in the habit of doing now in regard to its variety. It also leads to the conclusion that at the present



FIG. 6. PRODUCE OF EACH OF THE THREE LINES OF ENDURANCE POTATOES ENTERED FOR CERTIFICATION AND TESTED AT ASHBURTON.

The figures represent yield of table potatoes per acre. The highest-yielding row was rejected during the second field inspection on account of eelworm infection, and the lowest one owing to wilt-disease.

juncture potato variety trials are useless as an indication of cropping-power, since there is as much variation within the variety as is likely to occur between one variety and another.

YIELDS FROM THE ASHBURTON PLOTS.

The trial rows, each representative of a crop entered for certification, were grown under uniform conditions and in such a way that they could be very easily compared. Replication of the plots was not

possible, but so great were the differences that no amount of experimental error could account for the variations, and the point at issue is very clearly demonstrated.

It is to be regretted that time was not available to weigh all certification lines. This was done only in the case of three varieties—Dakota, Up-to-Date, and Endurance. It is probable that other varieties, with the possible exception of Bresee's Prolific, would have shown as great a variation as is proved to exist in the three varieties referred to. In Table 4 is recorded the yields of table tubers obtained, and Fig. 7 shows graphically the range of this variation in the

Table 4.—Yield of Table Potatoes in Certification Lines of Dakota, Up-to-Date, and Endurance, Ashburton Experimental Farm, 1927-28 Season.

Row No.	Tons per Acre.	Row No.	Tons per Acre.	Row No.	Tons per Acre.
<i>Dakota.</i>					
13 ..	8.3	7 ..	5.7 [†]	32 ..	4.5
31 ..	8.0	11 ..	5.5	35 ..	4.5
6 ..	7.8	14 ..	5.3*	12 ..	3.6
8 ..	7.6	34 ..	5.3	15 ..	3.5
33 ..	6.8	16 ..	5.2*	30 ..	3.2†
10 ..	6.4	23 ..	5.2	24 ..	3.1
22 ..	6.1	17 ..	4.9*	18 ..	3.0†
5 ..	6.0	25 ..	4.8	21 ..	2.7†
26 ..	5.9	20 ..	4.7	19 ..	2.1
9 ..	5.8				

Average, 5.2 tons per acre.

Up-to-Date.

150 ..	7.4	141 ..	5.6	147 ..	4.4
144 ..	6.1	143 ..	5.3	140 ..	4.3
142 ..	6.0	148 ..	5.3	145 ..	3.6
146 ..	5.7	149 ..	4.9		

Average, 5.3 tons per acre.

Endurance.

135 ..	9.5	134 ..	7.6	133 ..	4.6
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Average, 7.2 tons per acre.

* Seed originated from the one grower.

† Seed originated from the one grower.

Dakotas. This range extends from 8.3 tons down to 2.1 tons of table in the case of Dakota, from 7.4 tons to 3.6 tons in Up-to-Date, and from 9.5 tons to 4.6 tons in Endurance. It is interesting to note that the highest-yielding line in both Dakota and Up-to-Date was sent in by the one grower. His crops, which were grown on very light land, were, from the point of view of yield, among the poorest inspected. Had it not been for the trial plots at Ashburton the cropping-power of his lines would not have been discovered, except that he happens to be a recognized grower of high-class seed.

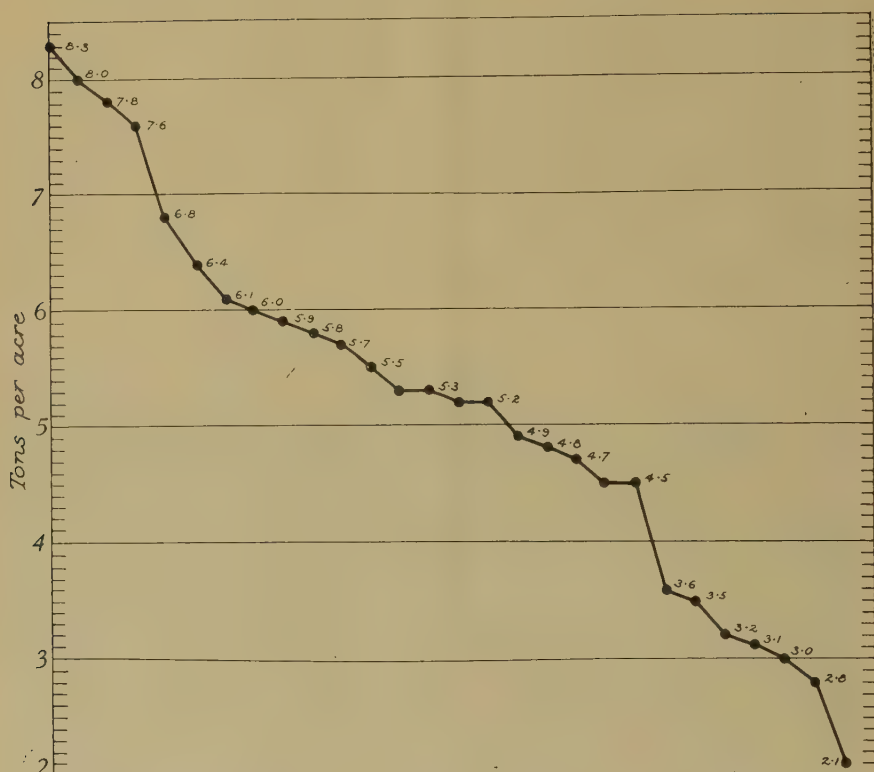


FIG. 7. SHOWING GRAPHICALLY THE RANGE IN YIELD OF TABLE TUBERS PER ACRE OBTAINED FROM TWENTY-EIGHT CERTIFICATION LINES OF DAKOTA AT ASHBURTON.

CAUSE OF UNPRODUCTIVENESS.

The reason for certain lines being unproductive cannot be discussed here at any length. The great majority have "run out" or degenerated, and some growers who are paying marked attention to purity are badly neglecting the general health or cropping-powers of their crops.

Degeneration is almost entirely due to the group collectively referred to as "virus" diseases. So far as is known, the condition is not brought about by ordinary fungi, bacteria, or micro-organisms, hence the term "virus," but they are nevertheless diseases, since they can be transmitted by grafting, by the juice of infected plants, and in the field by the agency of insects such as the green aphid so common on the potato-plant.

The various forms of virus disease have been or are being classified, and, without going into the question here, growers will no doubt recognize by the illustrations in this article conditions observed in their own crops. (Figs. 8, 9, and 10.) Instances in which the old tuber does



FIG. 8. LINE OF POTATOES (CENTRE ROW) BADLY "RUN OUT" WITH LEAF-ROLL.

Such plants are a menace to healthy plants around, and to healthy crops in the neighbourhood, infection being spread in the field by insects such as green aphid.

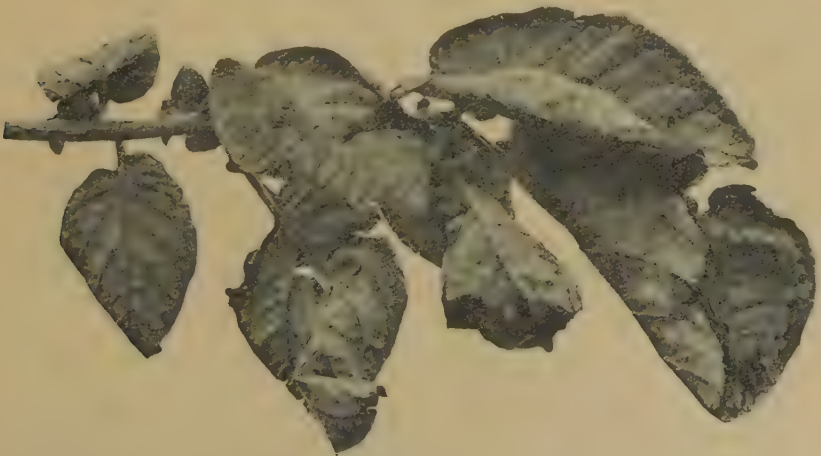


FIG. 9. TYPICAL LEAF-ROLL—LEAVES HARSH, THICKENED, AND ROLLED UPWARDS.



FIG. 10. STUNTED PLANT (IN FOREGROUND) AFFECTED BY SEVERE MOSAIC DISEASE.

Leaves have a mottled appearance and are generally crinkled. Yield is substantially reduced. Remarks on leaf-roll also apply to mosaic.

not rot away are common, and form an easily recognized symptom of virus disease. That such plants produce a poor yield is commonly observed by diggers, and seed from such roots, or from crops where this peculiarity occurs frequently, should not be used for planting. The symptoms of virus disease vary according to variety and climate, and so far it has not been possible to determine its presence from an examination of the tubers, these being quite normal and healthy in appearance. The important point is that virus diseases cause a very great reduction in yield; that tubers carry the disease so effectively masked as to baffle recognition; and that once a tuber is diseased all its stock is apparently permanently and incurably affected.

Noxious Weeds Orders.—Barberry has been declared to be a noxious weed in Takaka County, and hemlock in Marton Borough. The Maniototo County Council has declared gorse *not* to be a noxious weed within that county.

FROST-PREVENTION FOR ORCHARDS.

(Continued.)

W. R. LLOYD WILLIAMS, F.H.Á.S., Orchard Instructor, Alexandra.

II.—FROST AND ITS OCCURRENCE.

THE fruitgrower who successfully controls disease in his orchard is one who knows something of its nature and methods of attack. In the same way, any one making an endeavour to prevent damage to his orchard or garden by frosts should at least have an elementary knowledge of the physical principles involved in the production of frost before he can hope to make a success of orchard heating.

When the temperature of the air falls below 32° F. there is said to be a frost. A frost may be a "white frost," when it is made patent by the appearance of crystals of ice or hoarfrost on exposed objects, or a "black frost" which can only occur when the atmosphere is very dry. In a black frost the dew-point is below the air temperature at the time of the frost. As is more fully explained below, a frost in temperate latitudes is usually confined to the layers of air near the surface. If the whole mass of the air, including that in the higher layers, is below freezing-point the condition is described in America as a "freeze." A freeze may accompany either a black or a white frost.

Temperature Inversion.

Should the day be warm and sunny the ground-surface is heated very considerably by radiation from the sun until its temperature becomes higher than that of the air in contact with it. When this occurs the latter is warmed by conduction of heat from the ground. This heated air rises, and is continually being replaced by cold air from above. The former continues to rise until it reaches air of the same temperature as itself. Any layer of cold air near the surface is thus gradually warmed up, so that by the middle of the morning the temperature of the air is highest near the ground. This state of affairs continues until about 3 p.m., when the amount of heat radiated from the ground begins to exceed that received from the sun and the ground temperature begins to fall. Soon the ground begins to cool the air in contact with it, thereby reversing the order of things and making the air near the ground colder than that higher up.

Fortunately for the grower intending to heat his orchard, atmospheric cooling does not usually extend to great heights, the temperature rising from the ground upwards until a height is reached when there is very little variation. This phenomenon is known as "temperature inversion," and is what makes orchard heating possible. The feasibility of heating depends on the existence at a moderate elevation above ground of a layer of air which is above freezing-point. With the same ground temperature, heating will be easier the more marked the inversion. The warmed air from the heaters rises, at the same time imparting heat to the surrounding air, until it reaches a height where its temperature is the same as that of the air with which it comes in

contact. The level at which the temperature of the surrounding air is higher than that of the heated air forms a "ceiling" or "blanket" (which the heated air cannot penetrate. The process of heating, therefore, needs only to be carried on until the temperature of the air below the "inversion" is all above freezing-point or whatever is regarded as the dangerous temperature. It is not necessary to "heat the whole atmosphere" as many people think, but merely the layer below the "ceiling." The inversion will be more or less pronounced according to the weather. If a strong wind is blowing, the different air-layers are mixed together and there will be no inversion. If the sky is cloudy the ground does not lose so much heat by radiation, so that the inversion is poorly developed. If a low temperature is experienced under these circumstances, therefore, heating is likely to prove difficult. On the other hand, the clearer and the stiller the atmosphere and the warmer the previous afternoon the more pronounced is the inversion likely to be. It is clear that in a "freeze," even if there is an inversion, heating must prove impracticable. The heating can be carried on until the inversion is removed, but thereafter the heated air will rise indefinitely and be carried away, while the body of the air still remains below freezing-point. It is possible that there was a freeze on the occasion of Field Test No. 3 (recorded in last month's *Journal*).

Several experiments were conducted to test the temperature inversion. (1) Temperatures were taken by Mr. Glasgow in a deep well-like hollow at the north-west corner of Mr. Bringans's orchard, between it and the dredge tailings. The hollow was some 35 ft. deep, cone-shaped and about 60 ft. across at the top. Following were the results, the figures representing degrees Fahrenheit.

Table 9.

—	13th Sept.	14th Sept.	15th Sept.	16th Sept.
Minimum at top of hollow ..	27.0	46.0	43.8	37.8
Minimum 15 ft. down ..	25.5	44.0	41.0	35.5
Minimum 33 ft. down ..	23.5	39.0	39.0	31.0

(2) On the night of 10th September, in conjunction with Mr. Glasgow, a more comprehensive test was arranged, the Alexandra Fire Brigade kindly allowing us the use of their practice stand and ladder in the recreation reserve for the purpose. Temperatures were taken regularly from midnight to 7 a.m. The thermometers, fully exposed, were placed at the following heights from the ground: (a) 1 in., (b) 1 ft., (c) 4 ft. 6 in., (d) 10 ft., (e) 18 ft. From the accompanying graph (Fig. 13), which shows the temperatures recorded by each instrument at the times indicated, it will be noted that the lowest temperatures recorded were—(a) 26.8° F., (b) 26.0°, (c) 29.2°, (d) 30.9°, (e) 32.5°. In other words, at 1 in. there were 5.4 degrees of frost; at 1 ft. there were 6 degrees, at 4 ft. 6 in. there were 2.8 degrees; at 10 ft. there were 1.1 degrees; and at 18 ft. from the ground the temperature was half a degree above freezing-point—a difference of 6.5 degrees between the 1 ft. and 18 ft. levels. The fact that the lowest thermometer read

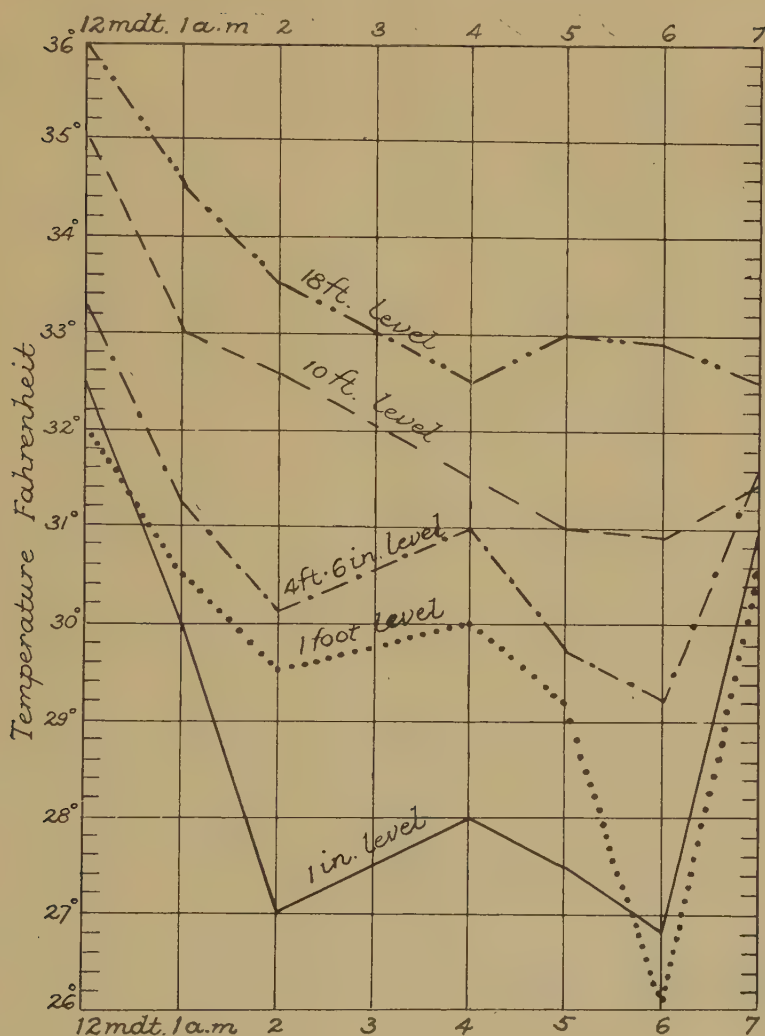


FIG. 13. GRAPH ILLUSTRATING TEMPERATURE INVERSION.

Experiment conducted 10th September, 1927, on Alexandra Fire-brigade's practice stand to ascertain temperatures at varying heights on a frosty night.

somewhat higher than that next above, was probably due to some defect in the instrument or its exposure.

(3) Tables 4 and 5 (last month's article) show differences in readings between thermometers A (4 ft. 6 in. level) and A/14 (14 ft.), up to $2\frac{1}{2}$ degrees, while Table 4 also shows thermometers F (4 ft. 6 in.) and F/14 (14 ft.), inside the heated area, with differences up to $3\frac{1}{2}$ degrees, these figures are despite the fact that the thermometers at 14 ft. were fully exposed and the others were under ordinary shelters.

Factors influencing the Occurrence of Frost.

(I) THE WEATHER.

This aspect may best be introduced here by reproducing the following extracts from an article on the "Protection of Orchards from Frost," by Dr. E. Kidson, in the *New Zealand Journal of Science and Technology* for November last:—

If the atmosphere is humid frost is less likely. The dew-point is the temperature at which the air would be saturated by the existing amount of moisture—i.e., the temperature at which it would be unable to take up any more moisture by evaporation. The minimum temperature is not likely to fall much below this, for once the dew-point is reached any further fall results in the condensation of water vapour. In the process of condensation it gives off a large amount of heat, and the fall of temperature is consequently checked. If, further, the temperature is low enough to cause the condensed moisture to freeze, still more heat is evolved. It is therefore difficult to cool the air much below its dew-point. Frequently when the dew-point is reached a ground fog will be formed, and this itself will tend to protect the trees from frost-action.

The cold air in the surface layers, being dense, or having a greater weight for the same volume than the warmer a few feet higher above the ground, will tend to flow over a land surface very much in the same way as water does. It will flow off the ridges into the gullies, and flow off sloping land into the valley-bottoms. On slightly undulating country it will collect in the hollows, producing what are called in America "frost pockets." Regions which receive the drainage from a large, cold mountain area, especially if it is snow-clad, will be more liable to damage than others. A gentle slope will be less frosty than the plain below. On a slope the ridges will be warmer at night than the hollows.

In some positions, such as a narrow gorge, the currents of cold air will converge until a moderate wind is caused, and the air-turbulence produced by the wind will result in the warm air from above being mixed with the cold surface layers, and a considerable rise in temperature will follow. Such a site may not, therefore, be as subject to frost as most of the surrounding country. There are several instances of this state of affairs in Central Otago. Cold currents may be deflected by steep hill-slopes, and so pursue a somewhat erratic course over the ground. It must be remembered that, owing to the decrease of temperature with height, the higher the altitude of a locality above sea-level the more it will, in general, be subject to frost.

The conditions which favour the production of frost are a clear, dry atmosphere and calm or only light winds, which at the same time allow the earth to radiate heat freely through the night sky, and the air which is cooled by contact with the ground to collect in a cold surface layer. Such conditions are found practically only in anticyclonic weather.

The weather in New Zealand is produced by a series of low-pressure waves or barometric depressions followed by areas of high pressure or anticyclones, all moving from the westward. As a depression approaches from the Tasman Sea the barometer will fall, and the winds will generally be from some northerly direction. Since they blow from lower latitudes, they bring warm and moist air with them. When the area of lowest pressure, or the "trough" of the depression, has passed there will be a change to southerly winds, which is usually fairly sudden. The southerly winds, coming from higher latitudes, flood the country with cold air. During this stage the barometer rises, and the weather, which has been generally wet and cloudy during the period of low pressure, gradually clears. As the crest of the wave of high pressure or the centre of the anticyclone approaches the winds fall off. The weather then will generally be clear, calm, and cold, especially over inland areas, and in the proper season frosts are likely. Frosts should be looked for, therefore, when the barometer is high and rising after a period of cold southerly winds. If snow has fallen on the surrounding country, or that lying to windward, the chances of frost are very much increased. On the other hand, if the ground is soaked with rain the danger is reduced.

The following remarks made by Dr. Kidson in a letter to the writer are also interesting and instructive :—

It is noted that the damaging frosts generally seem to be preceded by falls of snow or hail. There are various reasons why this should be so. First, these phenomena indicate low general temperatures. Hail also indicates a rapid fall of temperature with height, and therefore a cold upper air. Clear, still conditions are likely to follow these phenomena. Second, the snow surface radiates freely, and would produce cold air, which would drift down from the mountains. Third, a snow surface is about a fourth or a fifth as efficient a user of the sun's heat as a grass surface, so that there is not so much heating of the air during the daytime when the snow is about.

In the Alexandra district, which is near the foothills of the mountains, and in a region which is very broken, there appears to be comparatively little stagnation. There is, probably, also a considerable Föhn effect, producing relatively warm conditions. This is indicated by the warm temperatures which it experiences in spring for a station at such an altitude and in so high a latitude. Also, where there is a concentration of wind-currents, as in the Cromwell Gorge, these are sufficient to prevent severe frosts. Some such explanation is needed, too, to account for the fact that apricot-growing is so successful in the district. The critical months, September to November, especially the two last, are months in which strong westerlies prevail. The Föhn effect is therefore likely to be considerable. The liability to frost is consequently rather lower than in the Hastings district, where the mountains are more distant and lower, while the westerly winds are not so strong. In the Manuherikia Valley and the Upper Taieri there are more chances of stagnation and frost; in the Manuherikia because it is a wide valley in which the down-dropping winds have space in which to die down, and in the Taieri because, in addition, it is too far east for the Föhn effect to be felt to the same extent. These facts, while explaining the relative freedom of Alexandra from frost, also make it probable that temperature inversions are not likely to be so pronounced as in plain country, and that heating will be more difficult.

The Föhn wind mentioned is a warm wind from higher levels. Its warmth is accounted for by the increased pressure to which the air of which it is composed is subjected at the lower levels. At 5,000 ft., for instance, its temperature may be freezing-point, 32° F., and the pressure 25 in. When it reached sea-level its pressure would be about 30 in., and its temperature would be raised to 59° F. The effect is the same as that experienced when you pump up a bicycle-tire. The tire and pump get hot.

Many of Dr. Kidson's references have a very direct local bearing—for instance, the absence of damage in the Clyde-Cromwell gorge through which the Clutha River runs. Again, the formation of "frost pockets" is probably one of the main reasons why portions of Mr. Bringans's and adjoining orchards are almost invariably more or less frosted. Also, the reference to a gentle slop being less frosty than the plain below was well exemplified in the 45-acre orchard of Mr. R. T. Symes at Fruitlands. In this instance, on the lower portions the whole crop was frosted; part-way up, where the ground rises, a part crop was left; while at the top end, where there is a sharp rise, a full crop was harvested.

It has been stated, quite unscientifically, that damaging frosts never occur with the wane of the moon. Local experience last season was most interesting, and should refute such a misleading statement. There were frosts on the following mornings, the state of the moon being shown in parentheses: 28th August (new moon, 27th August); 17th September (full moon, 12th); 5th October (first quarter, 4th); 25th October (new moon, 26th); 14th and 15th November (full moon, 9th); 8th December (full moon, 9th). As will be noted by the experiments, the worst frost was that on 14th

November, followed by a less severe one the following day, when the moon was on the wane.

COVER-CROPS.

The question of cover-crops (or a cover of grass and weeds) appears to be a debatable one which requires further investigation. Several instances have been noted or brought under my notice which might lead one to believe that there is more danger where the ground is covered with a crop than under clean cultivation. These cases may be coincidences, and therefore it is wise not to be dogmatic on the subject until further looked into. Mr. P. A. Royds, an Alexandra tomato-grower, had one row of tomatoes on the south-east side of his patch, beside long grass, badly frosted by one of the earlier frosts, while the rest of the plot was untouched. The row was replanted, and was again badly frosted on 8th December, while the adjoining rows, although damaged, were not nearly so bad; at the same time the row at the other end of the block (north-west side), right alongside some green oats, was also badly frosted. Mr. Royds states that he always finds strawberries to be worse frosted in weeds than under clean cultivation; this happened in a nearby garden (Turner's) last season. He also states that some years ago one orchard in grass (McLean's) was the only one frosted, the surrounding ones being cultivated. At Mr. M. P. McGinnes's orchard, Earnsclough, there are two long rows of Roxburgh Red apricots side by side, with a strip of grass running along the side of one of them. The latter row showed a light crop, while the other, only a few feet away, carried a good crop. Some orchards under cover-crop in the Earnsclough district were appreciably damaged by frost while an adjoining cultivated one (certainly on slightly rising ground) received little injury. On the other hand, temperatures taken by me at 1.45 a.m. on 5th October, at 2 ft. 6 in. above the ground, registered alike—29° F.—on ploughed and unploughed ground, showing that further investigation is necessary.

SHELTER.

The matter of shelter forms a most difficult problem. It is generally accepted that the few rows of orchard trees on the leeward side of a windbreak are less injured by frost than those further away. This was noticeable at Mr. Hinton's orchard, the few rows near the road (southern) boundary, on which there is a poplar shelter, were not damaged as much as those a few rows away. At the same time it must be borne in mind that on the windward side the frost will be more severe. Moreover, shelters are likely to interfere with air-drainage, which is so essential in keeping the air moving and so preventing a frost. Much thought must be given the subject before providing shelter against frost, for the frost may not come exactly from the same direction each time, with the result that a shelter may prove the reverse and act as a stop-bank to prevent the outflow of cold air.

IRRIGATION.

Running water, which gives off heat as it cools, affords only a small amount of protection. If, however, no other means are available Californian authorities advise the running of water both day and night

during the whole period of the frost, but that it should only be looked upon as a means of partial rather than complete protection. In Mr. Royds's tomato patch last spring it was noticeable that the portion irrigated was only slightly frosted, and that the drier parts were frosted out, although some plants on the slightly higher ground in the driest part were untouched.

III. ECONOMIC FACTORS.

Injurious Temperatures.

Unfortunately, we have no local data sufficiently reliable on which to base an estimate of the temperatures which cause injury, and must therefore, in the meantime, rely upon American experience. The following extract is taken from Bulletin 398 of the Berkeley College of Agriculture of the University of California :—

Temperatures endured for Thirty Minutes or Less (Sheltered Thermometers) by Deciduous Fruits in various Stages of Development.

Kind of Fruit.	Stage of Development.		
	Buds closed but showing Colour.	Full Bloom.	Small Green Fruits.
	° F.	° F.	° F.
Apples	25	28	29
Peaches	25	26	29
Cherries	25	28	30
Pears	25	28	30
Plums	25	28	30
Apricots	25	28	31
Prunes	26	28	30
Almonds	26	27	30
Grapes	30	31	31

The fruit-buds of nearly all deciduous fruits are extremely susceptible to damage during the period of from twenty-four to forty-eight hours before they open. The petals are still folded, but the flowers are growing rapidly and are extremely tender. Buds in this condition are often injured by temperatures as high as those given in the table for small green fruits. Fortunately, most deciduous fruit-trees come into full bloom gradually, so that even if all the buds about to open at one time are killed, the size of the crop is not reduced materially. Buds of the Bosc pear often open simultaneously, and a low temperature just before the flowers open sometimes destroys most of the crop.

At the time generally designated "full bloom" most deciduous fruit-trees have large numbers of fruit-buds which are still tightly closed, in addition to the flowers which are fully open. This makes the loss of the entire crop, or even the greater portion of the crop, on one cold night, extremely improbable at this stage. This has led fruitgrowers in some districts to believe that frost can do no damage before the fruit has set. Some growers even follow the hazardous practice of leaving heaters unlighted on frosty nights during this period. While a single frost at full bloom seldom affects the size of the final crop, a series of heavy frosts, each killing a portion of the blossoms, may leave too few undamaged buds or blossoms for a full crop.

The most dangerous stage in general is after all the petals have fallen and the fruit has set. All the fruit being in nearly the same condition, the entire crop may be killed in a single night. It is at this time that orchard-heating operations should be most carefully conducted. Apples and pears at this stage of development usually are not seriously injured by a temperature of 28.5° F. for thirty

minutes or less, provided the duration of temperatures below 32°F . does not exceed three hours. If the temperature drops to 29°F . only a short time before sunrise and has not been below 32°F . more than three hours, heating is unnecessary. However, if it appears that the lowest temperature during the night will be below 29°F ., or if the temperature falls below 32°F . more than three hours before sunrise, heaters should be lighted and the temperature maintained as near 31°F ., as possible throughout the remainder of the night. Small green apricots are extremely tender just after the shucks (dried calices) have dropped and before the pits have hardened. Apricots in this condition have been injured at long-continued temperatures of 31°F ., and many growers think it necessary not to allow the temperature to fall below 32°F . as long as the pits are soft.

Different varieties of the same fruit often differ considerably in their susceptibility to frost damage. The Delicious apple appears to be more tender than most other varieties of apples grown commercially on the Pacific Coast. The Bosc pear is more susceptible to damage by frost than most other varieties of pears at similar stages of development, while the Winter Nelis is hardier than most varieties.

Frequency and Severity of Frosts.

Practically no scientific data are available as to the occurrences of frosts in Central Otago, but there is quite an appreciable amount of information of a practical nature. The main data from which these deductions are made are the temperatures taken by the Astronomical Society during 1922 and 1923 at Alexandra, Mr. H. E. Stevens from 1916 to 1921 at Clyde, and Mr. W. Bringans from 1919 to 1927 at Alexandra, and general talks with old-established growers. Although the information received from these sources cannot be wholly relied on, as temperatures have been taken in different situations and with non-standard thermometers, it must not be forgotten that the matter of frost damage has always been of vital interest to the fruitgrowers, and they naturally have a very good idea of what number of degrees of frost recorded by their own instruments would injure their crops.

During the years 1916 to 1927 inclusive there appears to have been an average of under three frosts per year which might have done more or less injury. From Mr. Bringans's records it would appear that his orchard received a certain amount of injury (not always more than a heavy thinning) from two frosts per year over the last nine years. The largest numbers were in 1919 and 1920, when there were six and four frosts respectively. The most severe frost recorded was one of 9° , which occurred in both 1919 and 1926, the temperature being observed by means of a thermometer placed on the ground in an exposed position. It would therefore be fairly safe to assume that the average is very little more than two frosts per annum for which heating will be required. For the longest frost experienced last season one and three-quarters hours' burning would have been sufficient for protection. To be on the safe side, therefore, and to allow for false starts, my estimates are based on an annual average of three heatings of two hours each.

Losses and Character of Injury.

Losses from frost damage are injurious to the whole community as well as to the fruitgrower and his industry. The grower is injured through lack of income, and his general inability to give his orchard that care and attention which is necessary whether there is a crop or not. This was very noticeable in Central Otago as a result of the 1926

frosts, when spraying, irrigation, cultivation, and other essential work was neglected. Moreover, the orchardist has all his overhead expenses, such as interest or rent, to pay, and the damage occurs after his pruning and ploughing have been completed, much of his spraying done, and most of his supplies ordered for the season. The Government suffers through the lesser tonnage carried on the railways, and the smaller amounts collected in income-tax and Customs duty. The industry generally receives a set-back through high prices forcing consumers to turn to other products, the lack of continuity of supplies being an important factor in the marketing of any commodity.

Sufficient details are not available to gauge the actual loss through frost sustained by growers in this district, but some idea may be gained by a comparison of the railway returns kindly supplied by Mr. C. Ashley, Stationmaster, Alexandra. The total weight of fruit railed from the railway-stations from Cromwell to Lauder on the Otago Central line for the years ended 31st March, 1926 and 1927 respectively, was 3,584½ tons and 2,616¼ tons, showing a decrease of 968 tons in the year of the severe frosts. This weight approximately equals 45,000 bushels. The following are the amounts of fruit (practically all stone-fruit) railed from Alexandra in the years 1921 to 1928 during the months of January and February, together with comments on the amount of frosting experienced:—

Table 10.

Year.	Tons.	Remarks.	Year.	Tons.	Remarks.
1921 ..	391	Considerable amount of frost.	1925 ..	862	Some apricots frosted.
1922 ..	744	Some frosting.	1926 ..	736	A little frosting.
1923 ..	946	Very little frosting.	1927 ..	145	Very severe damage by frost.
1924 ..	938	No frosting.	1928 ..	885	A little frosting.

The total loss estimated by the local fruitgrowers' association as a result of the 1926 frosts was £25,000 to £30,000—probably a conservative estimate. Although the losses at times have been heavy the district, apart from frosts, is so eminently suited to stone-fruits that growers who had been established for any length of time were quite well able to weather the storm. Moreover, it must be remembered that as one swallow does not make a summer, neither does one frosty season mean a failure, or greatly depreciate the many natural advantages possessed by Central Otago as a stone-fruit-growing area. The alarmist reports broadcast over the country have often been greatly exaggerated to the detriment of the industry.

There are also frost losses of a different character to be taken into account, such as malformations which make only second-grade fruit. Some varieties of apples and pears show an ugly russeting around the eye, while some pears, such as Williams Bon Chretien, develop a wide russet ring around the fruit. Another injury noticeable, especially on Cleopatra apples (Fig. 14) is the formation of small depressions or dents on the surface of the fruit which have the appearance of bitter-pit. When the skin is peeled there is nothing apparent but a slightly darker

green appearance. If cut a little deeper a corky layer is reached, and below this again is a distinct hole which has evidently healed over and does not appear to have any detrimental effect on the keeping-qualities of the fruit.

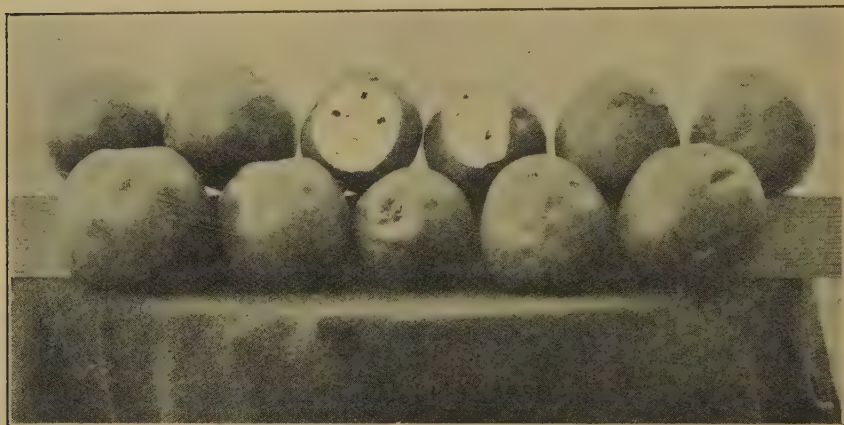


FIG. 14. FROSTED CLEOPATRA APPLES.

Note the depressions on the surface of the skin. On the cut apples will be seen the corky material near the skin and the holes where the cut is deeper.

Mr. J. R. Laing has noticed that "strong-growing trees of any variety stand the frost better, and carry heavy crops while the weaker trees among them are almost barren. Jonathan, Sturmer, and Cox, if they are frosted at the blossom stage and are heavily spurred all over, will throw out fresh blossoms and bear fair crops. Delicious and Cleopatra do not possess the recuperative powers of the others. Apples have, so to speak, five lives: when properly set they have five pips. Should they all be frosted but one there is a chance of the apple growing, although it will be badly shaped. Good apples may be grown with only two, three, or four pips; the difference is that they are flatter in shape and have not the substance of a perfect apple."

It was very noticeable during the season 1926-27 that pears, particularly Winter Cole and Winter Nelis, were dropping for no apparent reason at different times when they had nearly reached full size. Upon being cut, invariably the seeds were affected; one, two, or at most three of the seeds on one side would be full-grown and plump, the rest being shrivelled; moreover, in spite of light crops, these varieties did not size up as was naturally expected.

Will Frost-prevention Pay?

The individual grower is the only one who can finally answer this question. There appears to me to be three factors which should guide growers in this district in their decisions: (1) Is sufficient damage being done by frost to warrant the expense of protection? (2) Do damaging frosts occur so frequently that the cost

of protection would be too high? (3) Is the orchard sufficiently remunerative, irrespective of frost, to protect? There are orchards here that would not pay to protect from any of these points of view. Those orchards situated in favoured positions, such as the Clyde-Cromwell gorge, are frosted so seldom that the expense is certainly not warranted. Again, there are parts of the district with orchards in which, I am afraid, protection would be too costly, on account of the too frequent occurrence of damaging frosts. Then there are orchards that are not producing sufficiently large crops to warrant the additional expense, and which, until they can be brought into better profit, must be allowed to suffer occasional damage, for the cost of protection can easily be greater than the net profit on the crop saved.

There will always be failures on the part of those who do not exercise sufficient care and forethought, and there will always be a number who will not undertake protection against frost in any form. Therefore, for the successful frost-fighter there will be the higher price for his product in the years when frost takes toll of his neighbours' crops. In this district, with its dry autumn, the buds ripen to perfection, with the result apparently that, barring frosts, a full crop is assured each year almost invariably. Thus, with the frost boggy out of the way growers can with confidence apply manures and other assistance to their trees, with the almost sure knowledge that they are fertilizing a crop, instead of the present uncertainty. In the United States there is an annual increase in the acreage under protection from frost, and I feel that the same will be the case here. This conjecture is strengthened by the opinion of Dr. Kidson, as expressed to the fruitgrowers, that "it seems probable that frost-protection by artificial heating will be a paying proposition for many growers in Central Otago."

Community Organization.

Quite a considerable amount of co-operation is already being carried out by the fruitgrowers through their association in the purchase of equipment and fuel, and this has proved very beneficial, for such items as firepots become much cheaper when bought in large quantities. It seems probable that financial assistance can also be arranged to cover the initial costs of installing frost-fighting equipment through the intermediate rural credit system. There are other avenues for co-operation, as, for example, in the matter of several adjoining growers on the one telephone-line combining to purchase one alarm between them. This would be placed in the coldest of these orchards, a fact which would have been previously ascertained by taking a series of temperatures. Members of the group could then help each other in lighting and managing the fires.

In view of the probable early establishment of a climatological station at Alexandra, and subsequently, it is hoped, the stationing of a scientific investigator here, considerable assistance should be available in forecasting frosts and the amount of heating required to combat them.

(To be continued.)

COMMON AILMENTS OF LIVE-STOCK AND THEIR TREATMENT.

(Continued.)

J. LYONS, M.R.C.V.S., Director, Live-stock Division, Wellington.

Contagious Abortion.

THIS is a specific disease caused by a bacillus which sets up a catarrhal condition of the lining of the uterus recognized by the expulsion of the foetus at any time during the period of gestation.

The principal source of infection is through the alimentary tract and blood-stream, or the organism may gain entrance through the vagina per medium of the bull or through the female's hindquarters coming in contact with infectious material. When the infection reaches the uterus slow catarrhal inflammation is set up, which gradually separates the placenta or cleansing from its attachments. As the process proceeds the foetus is gradually deprived of nourishment, and is ultimately expelled as a foreign body. This may occur at almost any period during gestation, but most commonly takes place between the fifth and seventh months. The disease can be spread to certain other animals by inoculation, but is seen to the greatest extent among dairy cows. The ravages of the disease are felt throughout New Zealand, and in this respect we do not stand alone, as its effects are widespread in every other civilized country where dairying is carried on.

A feature of the disease is the extreme virulence shown when it first appears in a clean herd—any number up to 50 per cent. may abort. In each succeeding season the number of cases diminishes, until ultimately few are experienced, provided the farmer has been breeding his own stock and no fresh animals have been introduced. This is due to the fact that owing to the presence of the infection in the system a certain amount of immunity has been conferred. This is the stage at which the majority of our herds in New Zealand have arrived, as proved by the fact that the number of cases seen in any given herd is nothing like so great as was the case fifteen to twenty years ago. There are still exceptions, and the disease is still liable to be seen in a virulent form where the germ gains a footing in a clean herd.

In a pastoral country such as ours, where the herds range on pasture all the year round, the risk of infection and difficulty of control are greater than where the animals are housed for a considerable part of the year. In the latter case the cows are for the most part calved indoors, and the discharge after calving can be controlled and dealt with, thereby saving the pastures from contamination. It must be remembered that once a cow has aborted she remains a carrier of the disease more or less for the remainder of her existence, and, although she may carry her calf for the full time at each succeeding calving, being still a carrier she is spreading infection during each calving-period.

It will thus be seen that the matter of preventing the spread of fresh infection is a somewhat difficult one—in fact, it is almost impossible unless the owner is prepared to subject all animals in the herd to the agglutination test, separate the infected animals from the

non-infected, and run the herd in two different sections. Even then it would be necessary to see that the non-infected cows were placed on paddocks free from infection, and that hay or ensilage from land on which affected cows had been grazed before the material had been cut was not fed to the clean herd. Owing to the difficulties of segregation most owners prefer to take the risk of a few cows slipping each year. At the same time every effort should be made to lessen the risk of infection and far as possible keep it within bounds.

Symptoms.—There are no general constitutional symptoms in abortion disease, the general health of the animal remaining unimpaired throughout. If the animal is under observation preparatory symptoms will be seen, in some cases a few weeks but more frequently only for a few days, before the act takes place. Those seen in approaching parturition consist of swelling of the vulva, slackening of the pelvic ligaments on each side of the tail, and tension of the udder and teats. If the animal is in milk, curds and even blood may be noticed in the secretion, giving it the appearance of colostrum or beastings. In cases where the udder is not in active secretion milk can be observed in the gland. There is also a discharge of yellow gelatinous material from the vulva, and later uneasiness or slight straining may occur. If abortion takes place in the early period of gestation these symptoms are absent, the foetus being expelled in its membranes; and the first indication of what has taken place consists in the animal showing signs of returning to the bull.

When an animal aborts the afterbirth is retained usually for a few days, but in a few instances it may remain for weeks until it comes away in shreds. If the afterbirth is seen, at those parts where it has been attached to the womb a thick gelatinous, purulent material will be observed, and the same material is also attached to the womb. This exudes as a yellow purulent material which later turns to a brownish watery discharge. This discharge is highly infectious, and every effort should be made to see that it is not spread all over the farm by infected animals and thus become a source of further infection.

Prevention and Treatment consist in isolation. As soon as an animal shows signs of abortion she should be placed in a paddock reserved for this purpose and kept by herself. After the act the foetus should be burned or buried, and any membranes which come away should be treated similarly and not allowed to lie for dogs to carry about the premises. For the first few days the womb should be irrigated daily with a mild antiseptic solution, or pessaries may be used, after which, and before the animal is allowed to run with the rest of the herd, irrigation should be done at intervals until the discharge disappears. Such an animal should not be put to the bull for at least two and a half to three months after the date of abortion. All aborted cows in the herd should be treated similarly, and the paddocks should afterwards be hard grazed with sheep or with dry cattle intended for fattening. If these measures are strictly observed it will go a long way toward preventing the spread of further infection.

It must also be remembered that when the womb is inactive the abortion bacilli migrate to the udder and are secreted with the milk. This when fed to calves, although it does not affect them permanently,

passes through their digestive tract and may be a source of infection to other pregnant animals.

As a means of controlling the disease vaccines—both live and dead cultures—have been tried, but so far without affording relief. Experience in this respect shows that dead cultures are incapable of promoting either preventive or curative action, while although living cultures may confer some immunity their use is prohibited by the fact that they are absolutely dangerous, inasmuch as they may be an active agent in introducing the disease. Investigation and research into abortion disease has so far not given us a practical means of control, and in the light of our present experience we have still to depend on preventive measures.

Retention of the Afterbirth or Cleansing.

This is a condition which is frequently seen among our dairy herds during early spring, and forms a source of annoyance and indirect loss to the dairy-farmer. It is seldom seen among herds that are properly cared for and receive sufficient food to bring them to the calving season in good condition. But in herds that are allowed to become low in condition before calving, the trouble at times almost assumes epidemic proportions. Under such conditions the womb lacks sufficient tone to expel the membranes, with the result that it comes away in shreds. The toxins arising through putrefaction are absorbed into the system, which still further lowers the animal's vitality, and it may be months before she is fit to give her best if she ever does that season. It is difficult to estimate the loss from this cause, but in the aggregate it must be very considerable.

Retention of the afterbirth also occurs after abortion. In both cases it is lack of tone in the muscular coat of the womb which prevents that organ from contracting, a condition that must be present if the membrane is to be expelled.

The period at which the cleansing should be taken away varies in different subjects. On no account, however, should it be forcibly extracted, as under such conditions the results frequently prove disastrous. If on insertion of the hand and arm it is found that the cleansing adheres firmly, it should be left alone until it is less adherent. Before removal is attempted it is good practice to thoroughly cleanse the hands and arms in an antiseptic solution. The womb should then be douched with $1\frac{1}{2}$ to 2 gallons of warm water to which an antiseptic such as lysol or Jeyes fluid has been added. The hand should then be introduced and the membranes gently stripped from their attachment; this is a somewhat tedious process, but when the membranes are detached at a few centres a little further manipulation and traction is all that is necessary to bring the whole thing away.

The method just described cannot be practised by the every-day attendant, and should be left to those whose experience fits them to undertake the operation. A handy and safer method for the ordinary attendant is as follows: After the womb has been douched the visible membranes should be caught and twisted into a rope after raising them from the floor of the passage, and gentle traction applied. If it is

found that progress is being made the attempt should be continued; if not, the attendant should desist and resume the operation later on. In this manner the afterbirth can often be removed without any serious inconvenience to the animal.

One often meets with persons who have implicit faith in certain drenches as an aid to removal of the afterbirth. Such faith, however, is without foundation, as there is no medicine or combination of them that will bring about the desired effect. Nevertheless medicines have their uses under such conditions. It should be remembered that in cases of this kind toxins are more or less absorbed through the flaccid womb, and these act as a poison in the system. By keeping the bowels open the animal is enabled to get rid of this poison through the digestive tract. As a drench for this purpose nothing answers better than Epsom salts, $\frac{3}{4}$ lb. to 1 lb.; ground ginger, 1 oz.; and nux vomica, 2 drams—given in a quart of water or thin gruel. Hyposulphite of soda, 2 oz. to 3 oz.; ginger, 1 oz.; and nux vomica, 2 drams—given in the same way—also has a beneficial effect.

Septic Metritis (Inflammation of the Womb).

This trouble is generally met with as a sequel to retention of the cleansing, or it may occur without that condition being present, in which case the predisposing cause is an injury to the organ during parturition or clots of blood retained therein. It may occur, however, when none of these conditions is present, the casual organism being carried through the soiled hands or instruments of the attendant. The disease is not due to any specific organism, rather it is the result of a mixed infection. It is essentially a toxæmia accompanied by inflammation, the result of which frequently proves fatal, and if successful results are to follow treatment the disease must be diagnosed in its early stages. The trouble usually makes its appearance from two to five days after parturition, the symptoms varying according to the intensity of the inflammation.

Symptoms.—One of the earlier symptoms noted is general disturbance of the system, frequently introduced by rigours. Rumination is suspended; fever is indicated by rise in temperature; breathing is quick and shallow; the mucous membranes are highly infected; the pulse is rapid and weak; the appetite is entirely gone; and the secretion of milk almost ceases. At the onset of the attack constipation is present which soon gives place to diarrhœa fetid and dark in colour. The animal shows pronounced stiffness, especially of the hind quarters, and knuckles over on the hind fetlocks; when walking it frequently staggers. An anxious expression is present, the legs drawn together, and the head held low. If the animal is housed a peculiar odour exudes from the body, and in the later stages emphysematous conditions are seen beneath the skin. Straining is frequently present, and a discharge of chocolate-coloured material exudes from the vulva.

Treatment.—The animal should be made as comfortable as possible with suitable warm clothing, and the womb douched frequently with warm water to which an antiseptic such as Jeyes fluid has been added. Owing to the loose state of the bowels a purgative is not indicated, but considerable benefit will be derived by dosing the animal every

three or four hours with a mixture of hyposulphite of soda, 1 oz. to 1½ oz., and nux vomica, 2 drams, given in oatmeal gruel. The appetite should be encouraged by giving anything the patient fancies, in small quantities.

(To be continued.)

TESTING OF FRUIT-TREE STOCKS.

J. A. CAMPBELL, Director, Horticulture Division.

THE stocks on which fruit-trees are worked have an important bearing on crop results, and consequently this is a matter of vital concern to commercial fruitgrowers.

The Northern Spy stock at present generally used for apple-trees in New Zealand has the advantage of being immune to aphid attack, which was very troublesome previously. It also has the advantage of bringing trees into bearing at an early date. However, the trees remain comparatively dwarf on many classes of land, and growers desire a stock with a more vigorous influence. They point to trees on the same land bearing two or three times more fruit than the average tree on the Spy stock. Tests are being carried out by the Horticulture Division with a number of likely stocks, with a view to obtaining this vigour permanently without losing the advantages the Spy stock affords.

The apricot and cherry trees which form such an important feature of the fruitgrowing industry of Central Otago are growing on sundry and unknown stocks, many of these being very unsatisfactory. With a view to more exact knowledge, and to ascertain the best stocks for these trees under the special local conditions, all reputable stocks are now being tested for purposes of comparison.

The lemon and orange groves of Auckland Province are in a somewhat similar position; stocks suitable in other countries are not always suitable for local conditions. For instance, lemons on their own roots are popular in New South Wales, but in this country they are generally short-lived. The tests being carried out at Tauranga indicate that a vigorous lasting stock can be obtained for this purpose. They are also proving that a stock popular with some nurserymen is useless on most soils, and will compel a discontinuance of its use.

While in England last year Dr. C. J. Reakes, Director-General of Agriculture, and Mr. T. Rigg, of the Cawthron Institute, both visited the East Malling Experimental Station in Kent, and obtained much useful information on the work being carried out there in connection with fruit-tree stocks. Dr. Reakes also discussed means whereby the Horticulture Division would in future be kept in closer touch with this work through co-operation in activities.

COPPER CARBONATE DUST TREATMENT FOR SEED WHEAT.

OTAGO FARMERS' EXPERIENCE.

R. B. TENNENT, N.D.D., Instructor in Agriculture, Dunedin.

DURING the autumn of 1927 the use of copper carbonate dust for the control of stinking-smut (*Tilletia Tritici*) was introduced in a practical way to the wheat-growers of Otago by the treatment of small lines of their seed wheat by the Fields Division. In all some 2,130 bushels were treated. The bulk of this was done at a central depot in Oamaru, Messrs. Dalgety and Co. kindly giving the use of their grain-store for this purpose. Detailed experimental work was not carried out, but many of the farmers grew the copper carbonate treated seed alongside that treated with bluestone (copper sulphate) or formalin. Thus they were able to obtain a fair comparison of the treatments under general farming conditions.

Later in the year each farmer concerned was invited, by means of a questionnaire, to present his estimation of the copper carbonate treatment. Fully 90 per cent. acknowledged the superiority of this treatment over either bluestone or formalin after all factors had been considered. This contention is well supported by data obtained from carefully conducted experiments by the Department.

On analysing the questionnaires it is found that of the farmers who compared copper carbonate dusted seed with formalin treated seed 60 per cent. acknowledged a higher germination percentage, while 40 per cent. are of the opinion it was on the same plane in this respect. Fifty-five per cent. state that the dusted wheat germinated much quicker, while 45 per cent. state they could not notice any appreciable difference in this respect.

Of those who compared the dusted seed with bluestone 59 per cent. acknowledge a higher germination percentage, while 35 per cent. state the germination percentage to be the same; 6 per cent. state it was lower. Fifty-nine per cent. state it germinated much quicker, while the remainder state they could not recognize any great difference.

In no instance was the appearance of stinking-smut reported, and no trace of this disease could be found in the copper carbonate treated crops that were carefully inspected. Loose smut (*Ustilago Tritici*) was noticed in varying degrees of intensiveness, but it must be remembered that pickling with either formalin, bluestone, or copper carbonate does not control this disease.

The consensus of opinion is decidedly in favour of the dry method of pickling. A large proportion of the questionnaires were prefaced with remarks which should be convincing to those farmers who feel diffident about using this method. The following are typical examples: "We find it much easier to sow the seed; better and quicker germination; and the saving of half a bushel of seed per acre." "I have used copper carbonate for two seasons, and find a much stronger,

thicker, and more healthy and vigorous braid." "Came away a lot brighter-looking and quicker than the formalin; was very pleased with the result."

Copper carbonate treatment is not claimed to be more efficacious than either bluestone or formalin for the control of smut, but it has certain advantages which recommend it in preference to the wet methods. The usual formaldehyde or bluestone treatment generally causes some damage to the seed, and also reduces the promptness of germination and vigour of the seedlings to an appreciable extent, particularly when the soil temperature and moisture conditions are not favourable to quick germination. To lose up to 30 per cent. or more of the stand from liquid-treatment injury, especially when the solution has not been accurately prepared, is not uncommon, and this fact is not always sufficiently realized by wheat-growers.

Copper carbonate causes no injury to seed or seedlings. The grain comes up more promptly, and shows as a rule greater vigour than with liquid treatments. The treatment can be applied months ahead, if desired, with no ill effect to the seed during storage. The dry treatment is less troublesome to carry out, since no solutions of correct strength need be made up. The dust is generally applied at the rate of 2 oz. per bushel, but should this amount be exceeded by accident or otherwise no fear of damage to the seed need be entertained. As it has been definitely proved that copper carbonate dust does not lower the germination capacity or hamper the seedlings, farmers can safely lower their rate of seeding without fear of the resultant crop being thinner than usual.

A useful facility for our wheat-growers would be originated by seed-merchants attaching dusting-machines to their wheat-grading plants and adhering to the proposal that only graded wheat be treated. Undoubtedly many farmers would avail themselves of the opportunity of purchasing treated seed rather than treat it themselves, and by so doing a much larger acreage of graded seed would be sown than at present. The practice would thus be one of the contributing agencies for steadily improving the quality and prolificacy of our wheat crops.

INTRODUCTION OF MULBERRY VARIETIES.

ITALIAN settlers in Nelson District recently sought the assistance of the Department of Agriculture to introduce improved varieties of mulberry-trees for the raising of silkworms. These people have a good knowledge of sericulture, and have already taken it up here as a domestic sideline to their main activities of fruit-, tomato-, and tobacco-growing. The Department therefore readily took action to procure the desired stock from Italy. A supply of young trees of some half-dozen different varieties was received last month in excellent condition (through our High Commissioner in London) from a leading nursery firm in the Province of Venetia. The trees have been distributed to the best advantage, and may be expected to be increased by propagation in due course. It is considered that sericulture may also prove a sideline for other settlers in suitable districts.

BRAXY-LIKE DISEASE AND FLUKE IN SHEEP.

SUCCESSFUL CONTROL WORK REPORTED FROM HAWKE'S BAY.

C. S. M. HOPKIRK, B.V.Sc., Officer in Charge, Wallaceville Veterinary Laboratory.

It is very satisfactory to learn from the latest field report made by the Department's Veterinarian stationed at Hastings, Mr. E. E. Elphick, that those farmers who have diligently attempted to overcome the liver-fluke parasite, and consequentially the braxy-like disease affecting sheep in the fluke-affected area, have this season experienced a very small mortality. Many farmers, on the other hand, who have not been able to drain their swamps, dress with copper sulphate, or drench their sheep in this effort to control the fluke have already had considerable losses. The fact that the braxy-like disease has been so easily controlled by ridding the farm of liver-fluke is proof of the correctness of the view advanced in the *Journal* for September last that the fluke is the carrier of the disease organism into the liver.

A successful trial in lowering the expense of treating sheep for the adult fluke has recently been made on a large Hawke's Bay sheep-station with a mixture of paraffin oil (4 parts) and carbon tetrachloride (1 part). This mixture of oil and drug, which is easy to administer, as well as cheap, may be procured in 1-gallon tins at a cost of 15s. per gallon, this amount being sufficient for 800 sheep. It is necessary to buy one or two 5 c.c. syringes, without hypodermic needles. Among others, the Record pattern (price 12s. 6d.) may be recommended. Both ready-mixed drug and syringe can be obtained from Kempthorne, Prosser, Ltd., Wellington, at the prices mentioned.

An easy and safe method of drenching is to obtain a strong drenching-funnel and to squirt the syringeful of mixture into the mouth of the sheep through the funnel. This procedure protects the barrel of the syringe from injury, and also does not tire the hands of the operator to the same extent as when opening the mouth of each sheep forcibly by hand. With two men catching the sheep, and another holding a cup of the mixture, one operator can easily drench 1,000 sheep per day, and make sure that each sheep gets its full supply. With the capsule method of administration there is a possibility of the sheep dropping the dose before swallowing.

Any further particulars required may be obtained from the Veterinarian, Department of Agriculture, Hastings, Hawke's Bay.

INTERIM RETURNS OF LIVE-STOCK.

INTERIM returns of live-stock in the Dominion for the season 1927-28, issued by the Census and Statistics Office, show the following position as regards the leading items (final figures for 1926-27 being added in parentheses):—Dairy cows, 1,312,126 (1,303,225); total cattle, including dairy cows, 3,202,724 (3,257,729); horses, 299,112 (303,713); pigs, 567,874 (520,143); sheep shorn, 24,500,731 (23,441,808); lambs tailed, 13,484,243 (12,069,681); total sheep, 30th April, 1928, 27,001,236 (25,649,016). Full particulars of the interim sheep return are given elsewhere in this issue.

PASTURE TOP-DRESSING EXPERIMENTS IN OTAGO, SEASON 1927-28.

(Concluded.)

R. B. TENNENT, N.D.D., Instructor in Agriculture, and A. A. HOME, A.R.C.Sc.I.,
Assistant Instructor in Agriculture, Dunedin.

South Otago.

IN South Otago sixteen new plots were laid down, in addition to three which had been established during the season of 1926-27, thus making a total of nineteen plots well distributed throughout the southern portion of the province. These experiments were the last of the series laid down, consequently all applications of fertilizers were made at what can be considered a late date. As was expected, a number of the plots showed no increase from lime, and very small increases from the various fertilizers. In perusing the results here presented the lateness of application must be constantly kept in mind. Fortunately, the experiments are intended to cover a period of four years, and it may be confidently expected that the effect of late top-dressing this year will be compensated for by next year's weighings.

The results of the plots laid down during season 1927-28 are recorded hereunder. The two-year results of the three plots laid down in season 1926-27 will be dealt with in a separate article.

(23) COCKBURN BROS., TE HOUKA.

This pasture situated on the banks of the Molyneux (Clutha) River had been sown down in 1922 with a mixture of timothy and clovers, but had not been top-dressed. At the time that the present experiment was laid down it had run mostly to inferior grasses, clover being hardly noticeable. The plot was top-dressed on 2nd September, 1927, closed to stock on 25th October, and harvested 4th January, 1928. Results are shown in the following table:—

Table 18.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£. s. d.	£. s. d.	£. s. d.
30	Basic slag ..	41.6	S	1 16 1	9 1 3	0 15 0	0 8 9 (gain)
30	Basic slag and lime	42.0	S	1 16 3	9 3 9	1 8 0	0 1 9 (loss)
30	Super ..	52.8	S	2 6 1	11 11 3	1 1 0	2 12 9 (gain)
30	Super and lime ..	56.0	S	2 9 0	12 5 0	1 14 0	2 13 6 (gain)
35	Lime ..	38.0	N	1 13 1	8 6 3	0 13 0	0 4 3 (loss)
..	Control ..	36.4	..	1 11 2	7 17 6	..	..

Summary: Superphosphate and lime gave the best results on this plot, with super alone not very much lower. The clover-growth on these strips was very marked. Basic slag showed a slight increase, but

had not the clover content of the superphosphate strips. Lime alone gave a very slight increase over the control.

(24) G. L. CUNNINGHAM, HILLEND.

This plot is situated on the rolling country towards Awamangu, and had been sown down in the winter of 1921 with rape, a mixture of rye-grass, cocksfoot, crested dogstail, and clovers. The plot was top-dressed in 1924 with $\frac{1}{2}$ cwt. of Nauru phosphate, and $\frac{1}{2}$ cwt. superphosphate per acre. In the spring of 1927, when the experiment was commenced, the pasture had run practically to brown-top. The plot was top-dressed on 7th August, 1927, closed to stock on 25th October, and harvested on 6th January, 1928. Results are tabulated below.

Table 19.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
30	Basic slag ..	12.9	N	0 11 1	2 16 3	0 15 0	0 8 9 (loss)
30	Basic slag and lime ..	12.7	N	0 11 0	2 15 0	1 8 0	1 3 0 (loss)
30	Super ..	12.7	N	0 11 0	2 15 0	1 1 0	0 16 0 (loss)
30	Super and lime ..	12.6	N	0 11 0	2 15 0	1 14 0	1 9 0 (loss)
40	Lime ..	12.2	N	0 10 2	2 12 6	0 13 0	0 10 6 (loss)
..	Control ..	11.6	..	0 10 0	2 10 0	..	..

Summary: An examination of these results reveals the fact that there is no apparent increase due to any manure or mixture of manures that had been applied. A close inspection of the superphosphate and basic-slag strips showed that there was a semblance of clovers coming in, which will more than likely make more interesting results in the subsequent years of the experiment.

(25) A. AND A. CRAIG, GREENFIELD.

The pasture selected for this experiment is situated on rolling country somewhat akin to that of the preceding test, and had been sown down some considerable time with the usual grass and clover mixture. At the date of top-dressing it had run out very badly to sweet vernal and crested dogstail, there being a dearth of clover growth. The plot was top-dressed on 5th September, 1927, closed to stock on 25th October, and harvested on 6th January, 1928. Results are presented in Table 20 (next page).

Summary: No very marked differences were observed during the growing-period. When harvesting the plot a slight increase in the superphosphate weighing was observed, which was due to the increase in clover-growth. The effect of lime in conjunction with super or basic slag made no apparent change, while lime alone showed little more than the control on this year's results. Owing to the lateness

Table 20.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
30	Basic slag ..	16.4	N	0 14 1	3 11 3	0 15 0	0 3 9 (loss)
30	Basic slag and lime	15.73	N	0 13 3	3 8 9	1 8 0	0 19 3 (loss)
24	Super ..	17.2	N	0 15 0	3 15 0	1 1 0	0 6 0 (loss)
24	Super and lime ..	15.1	N	0 13 0	3 5 0	1 14 0	1 9 0 (loss)
30	Lime ..	13.9	N	0 12 1	3 1 3	0 13 0	0 11 9 (loss)
..	Control	13.6	..	0 12 0	3 0 0	..	..

of the season when the plot was top-dressed, this is not surprising. It is anticipated that definite increases will be observed next season.

(26) V. WILSON, GREENFIELD.

This plot, situated on the light flat country at Woodend, had been sown down in 1920 with rye-grass, cocksfoot, and white clover. At the time of top-dressing the pasture was in a very poor state, having gone back to Yorkshire fog, sweet vernal, and weeds, with a little cocksfoot still persisting. The plot was top-dressed on 6th September, 1927, closed to stock on 25th October, and harvested on 7th January, 1928. Results were as follows:—

Table 21.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
24	Basic slag ..	18.1	N	0 15 3	3 18 9	0 15 0	0 13 9 (loss)
24	Basic slag and lime	18.8	N	0 16 2	4 2 6	1 8 0	1 3 0 (loss)
24	Super ..	20.8	N	0 18 1	4 11 3	1 1 0	0 7 3 (loss)
24	Super and lime ..	21.1	N	0 18 2	4 12 6	1 14 0	0 19 0 (loss)
32	Lime ..	18.0	N	0 15 3	3 18 9	0 13 0	0 11 9 (loss)
..	Control ..	17.8	..	0 15 2	3 17 6	..	..

Summary: So far no significant increases in weight have been obtained from the weighings of this plot. The fact is to be recorded, however, that in those strips top-dressed with superphosphate alone, and super in conjunction with lime, slightly heavier weighings were obtained, the difference being due largely to an increased clover content in the strips thus treated. Lime showed no apparent improvement, nor could it be reasonably expected to do so when the lateness of its application is borne in mind.

(27) C. BODY, KELSO.

The pasture on which this experiment was carried out is situated on the foothill country adjacent to Kelso. Sown down in 1924 with rye-grass, crested dogstail, and white clover, at the time of top-dressing it had deteriorated, being more or less open and occupied with weeds such as epilobium, which was very much in evidence. Crested dogstail held to a certain extent, while Yorkshire fog was very profuse. The plot was top-dressed on 12th September, 1927, closed to stock on 18th October, and harvested on 11th January, 1928. Following are the results:—

Table 22.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
20	Basic slag ..	23.0	N	1 0 0	5 0 0	0 15 0	..
20	Basic slag and lime	24.1	S	1 1 0	5 5 0	1 8 0	0 8 0 (loss)
30	Super ..	24.2	S	1 1 1	5 5 0	1 1 0	0 1 0 (loss)
30	Super and lime ..	24.3	S	1 1 1	5 6 3	1 14 0	0 12 9 (loss)
30	Lime ..	21.8	N	0 19 0	4 15 0	0 13 0	0 3 0 (loss)
..	Control ..	19.5	..	0 17 0	4 5 0	..	..

Summary: The variation of the effects of the different manures used on this plot was very slight. Although both fertilizers used showed an increase over the control plot, the application of lime did not tend to increase that yield. Lime alone showed a slight increase over the unlimed portion.

(28) S. OTTREY, HERIOT.

The pasture used for this trial is situated on rolling country, the soil being of a light texture, and had been sown down with rye-grass, timothy, and white clover. At the time of top-dressing the pasture was of a very open nature, due to some extent to the ravages of the

Table 23.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-signi- cant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.			Cost of Manure per Acre.			Profit or Loss compared with Unmanured Plot.		
		lb.		T. cwt. qr.	£	s.	d.	£	s.	d.	£	s.	d.
24	Basic slag ..	13.1	N	0 11 1	2	16	3	0 15	0	0 13	9	(loss)	
24	Basic slag and lime	13.6	N	0 11 3	2	18	9	1 8	0	1 4	3	(loss)	
30	Super	14.3	N	0 12 2	3	2	6	1 1	0	0 13	6	(loss)	
30	Super and lime ..	14.4	N	0 12 2	3	2	6	1 14	0	1 6	6	(loss)	
30	Lime	13.7	N	0 11 3	2	18	9	0 13	0	0 9	3	(loss)	
..	Control	12.8	..	0 11 0	2	15	0	..	..	..	..		

grass-grub. Weeds were taking possession of the bare patches, while the rye-grass was of a very spindly character. The plot was top-dressed on 13th September, 1927, closed to stock on 18th October, and harvested on 13th January, 1928. Results are shown in Table 23.

Summary: The results were unsatisfactory. Very little growth had taken place, as is borne out by the small weighings. There was little or no clover in the control or basic-slag strips, while the superphosphate strips showed just a semblance of white clover.

(29) J. COTTON, BELLAMY, EVANS FLAT.

Sown down in 1920 with rye-grass, crested dogstail, and clover, this pasture had at the time of top-dressing run to brown-top. The plot is situated on rising ground of a light nature. It was top-dressed on 14th September, 1927, closed to stock on 18th October, and harvested on 16th January, 1928. Results were as under:—

Table 24.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
30	Basic slag ..	7.0	N	0 6 1	1 11 3	0 15 0	0 10 0 (loss)
30	Basic slag and lime	7.1	N	0 6 1	1 11 3	1 8 0	1 3 0 (loss)
30	Super ..	9.1	N	0 8 0	2 0 0	1 1 0	0 7 3 (loss)
30	Super and lime ..	7.5	N	0 6 2	1 12 6	1 14 0	1 7 9 (loss)
35	Lime ..	6.8	N	0 5 3	1 8 9	0 13 0	0 10 6 (loss)
..	Control ..	6.1	..	0 5 1	1 6 3	..	..

Summary: This is one of the plots with which the estimation of results by weighing does not do justice to the effect of the manures. Although there is comparatively no difference in the weighings, there was a vast difference in the composition of the strips. The growth was small, but on the superphosphate strips white clover was coming in to a marked extent.

(30) A. TWEED, MONEYMORE.

This pasture had been sown down in 1925 with rye-grass, crested dogstail, clover, and alsike, and at the time of top-dressing it was in quite good condition. The rye-grass was perhaps not so vigorous as might have been expected, but, except for the presence of some Yorkshire fog, the pasture was in ideal condition for trying the effects of the various manures. The plot was top-dressed on 31st August, 1927, closed to stock on 1st November, and harvested on 17th January, 1928. Table 25 presents the results.

Summary: Considering the high fertility of this pasture when top-dressed, the results were an indication of the increased growth that can be obtained from judicious top-dressing. All manures used, also

Table 25.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
30	Basic slag ..	31.3	S	1 7 1	6 16 3	0 15 0	0 6 3 (gain)
30	Basic slag and lime	33.8	S	1 9 2	7 7 6	1 8 0	0 4 6 (gain)
30	Super ..	33.95	S	1 9 3	7 8 9	1 1 0	0 12 9 (gain)
30	Super and lime ..	35.0	S	1 10 2	7 12 6	1 14 0	0 3 6 (gain)
40	Lime ..	28.5	N	1 4 3	6 3 9	0 13 0	0 4 3 (loss)
..	Control ..	26.4	..	1 3 0	5 15 0	..	..

lime gave a response, but the highest yield was obtained from super-phosphate plus lime. Super alone, on this year's results, was the most payable proposition. Basic slag, with and without lime, also gave definite increases over the control plots. Clover-growth in each case was responsible for the increased weights.

(31) D. MCG. REID, MARAPUNA, MILTON.

This plot is located on the Tokomairoro Plain, at Milton. The pasture had been laid down in 1924, the grasses used being perennial and Italian rye-grass, cocksfoot, and clovers. At the time of top-dressing the pasture was chiefly composed of cocksfoot and some of the minor grasses and white clover. The plot was top-dressed on 31st August, 1927, closed to stock on 1st November, and harvested on 17th January, 1928, with the following results:—

Table 26.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
30	Basic slag ..	31.6	S	1 7 3	6 18 9	0 15 0	0 13 9 (gain)
30	Basic slag and lime	41.2	S	1 16 0	9 0 0	1 8 0	2 2 0 (gain)
30	Super ..	36.4	S	1 11 3	7 18 9	1 1 0	1 7 9 (gain)
30	Super and lime ..	43.3	S	1 17 3	9 8 9	1 14 0	2 4 9 (gain)
30	Lime ..	30.2	S	1 6 1	6 11 3	0 13 0	0 8 3 (gain)
..	Control ..	24.5	..	1 2 0	5 10 0	..	..

Summary: In all instances there was a decided increase over the unmanured plots. Lime alone, and used in conjunction with both super and basic slag, has shown up remarkably well, considering the fact that the lime was applied in the form of carbonate. Super and lime gave the greatest response, while basic slag and lime came next. Super gave a far higher yield than basic slag, which itself had a marked

increase over the control plot. The cocksfoot in the manured strips, together with increased clover-growth, were responsible for the increased yields.

(32) W. B. PATERSON, STUART DOWNS.

The pasture on which this trial was conducted is situated on the hill country near Creighton. The pasture had been sown down in 1923 with rye-grass, crested dogtail, and clover. At the time of top-dressing the paddock had deteriorated to such an extent that practically none of the original grasses remained, and to all intents and purposes it could be looked on as a brown-top and sweet vernal pasture devoid of clovers. The plot was top-dressed on 1st September, 1927, closed to stock on 1st November, and harvested on 18th January, 1928. Results are tabulated below:—

Table 27.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
24	Basic slag ..	4.9	N	0 4 1	1 1 3	0 15 0	0 15 0 (loss)
24	Basic slag and lime	5.4	N	0 4 2	1 2 6	1 8 0	1 6 9 (loss)
30	Super ..	6.6	N	0 5 3	1 8 9	1 1 0	0 13 6 (loss)
30	Super and lime ..	7.1	N	0 6 1	1 11 3	1 14 0	1 4 0 (loss)
30	Lime ..	5.4	N	0 4 2	1 2 6	0 13 0	0 11 9 (loss)
..	Control ..	4.8	..	0 4 1	1 1 3	..	..

Summary: As in the case of J. Cotton's plot, at Bellamy, only small weighings could be obtained, and little information can be gleaned from the actual figures. There was practically no difference between the unmanured and manured strips at the time of harvesting, and there was no visible indication at that time to differentiate between the superphosphate and the basic-slag strips. But at the beginning of April, on the aftermath, the clover content of the superphosphate and basic-slag strips was quite distinct. Second year's results in such a case ought to be more favourable to the manured plots.

(33) R. KINNARD, MAUNGATUA.

Situated on the Taieri Plain, near Maungatua, this pasture had been sown down in 1920 with a mixture of rye-grass and clovers. At the time of top-dressing it was in fair condition, a good sōle of grass and clover prevailing throughout. The paddock was top-dressed on 22nd July, 1927, closed to stock on 1st November, and harvested on 18th January, 1928. Table 28 gives results.

Summary: Excellent results were obtained from the fertilizers used. Lime alone gave a good response. The highest yield was obtained from super and lime, although super alone proved a very payable proposition. Basic-slag, with and without lime, showed a decided increase over the

Table 28.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plots.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
24	Basic slag ..	51.9	S	2 5 1	10 11 3	0 15 0	1 0 0 (gain)
24	Basic slag and lime	52.0	S	2 5 1½	10 11 10	1 8 0	0 7 7 (gain)
30	Super ..	54.8	S	2 7 3	11 18 9	1 1 0	2 1 6 (gain)
30	Super and lime ..	57.9	S	2 10 2	12 12 6	1 14 0	2 2 3 (gain)
35	Lime ..	46.6	S	2 0 3	10 3 9	0 13 0	0 14 6 (gain)
..	Control ..	40.3	..	1 15 1	8 16 3	..	..

unmanured plots, but although not visible to the eye at the time of harvesting the superphosphate plots proved superior. Clover-growth again was responsible for the increase in weights over the control plots.

(34) J. WITHERS, MAUNGATUA.

The pasture selected for this experiment is situated on the foothills of Maungatua, and had been sown down about the year 1918 with a rye-grass mixture and clovers. At the time of carrying out the trial the paddock had lost most of the rye-grass—cocksfoot, sweet vernal, and Yorkshire fog being the dominant grasses—while clover was barely visible. The plot was top-dressed on 21st July, 1927, closed to stock on 1st November, and harvested on 19th January, 1928. Results were as follows:—

Table 29.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
30	Basic slag ..	29.3	S	1 5 2	6 7 6	0 15 0	0 13 9 (gain)
30	Basic slag and lime	29.8	S	1 6 0	6 10 0	1 8 0	0 3 3 (gain)
30	Super ..	31.0	S	1 7 0	6 15 0	1 1 0	0 15 3 (gain)
30	Super and lime ..	29.6	S	1 5 3	6 8 9	1 14 0	0 4 0 (loss)
36	Lime ..	22.9	N	1 0 0	5 0 0	0 13 0	0 11 9 (loss)
..	Control ..	22.6	..	0 19 3	4 18 9	..	..

Summary: The superphosphate strips on this plot were clearly visible prior to cutting, due to the presence of white clover, and this fact reflected itself in the weighings. The application of lime on this season's growth was negligible. Basic slag, with and without lime, showed an increase over the control, but the differences were not so noticeable as on the superphosphate strips.

(35) A. J. SPENCER, BERWICK.

This plot, established on the Taieri Plain adjacent to the contour channel near Berwick, had been sown down about the year 1921 with a mixture of rye-grass, cocksfoot, timothy, alsike, and white clover. At the time of laying down the experiment the rye-grass had practically run out—some inferior grasses replacing it—while the clover content was very sparse. The plot was top-dressed on 29th August, 1927, closed to stock on 1st November, and harvested on 20th January, 1928. Following are results:—

Table 30.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
30	Basic slag ..	47.9	S	2 1 3	10 8 9	0 15 0	1 11 3 (gain)
30	Basic slag and lime	44.2	S	1 18 2	9 12 6	1 8 0	0 2 0 (gain)
30	Super ..	50.7	S	2 4 1	11 1 3	1 1 0	1 17 9 (gain)
35	Super and lime ..	51.2	S	2 4 3	11 3 9	1 14 0	1 7 3 (gain)
40	Lime ..	37.9	N	1 13 0	8 5 0	0 13 0	0 10 6 (loss)
..	Control ..	37.2	..	1 12 2	8 2 6	..	..

Summary: Fairly high weighings were recorded as the result of this trial. Superphosphate and super plus lime gave the greatest response. These strips were clearly defined by the presence of white clover and the abundance of alsike. Although basic slag, with and without lime, gave a considerable increase over the control plots, the type of herbage was not the same as that on the superphosphate strips. Lime alone did not give a response.

(36) MAJOR HICKEY, WAIPAHI.

This plot, situated on hill country adjacent to Waipahi, had been sown down in 1922 with a mixture of rye-grass, cocksfoot, dogstail, timothy, clovers, and trefoils. At the time of top-dressing the pasture had deteriorated considerably, and consequently inferior grasses had taken the place of the rye-grass to a great extent, while clovers were practically non-existent. The plot was top-dressed on 21st September, 1927, closed to stock on 25th October, and harvested on 23rd January, 1928, with the following results. Results are shown in Table 31.

Summary: Growth was very meagre on this plot, the weighings being consequently very small. Superphosphate, with and without lime, gave nearly twice the return of the unmanured plot, due largely to the growth of suckling clover, very little white clover being present. The basic slag and basic slag with lime strips did not show up to an appreciable extent, and lime alone gave a negligible increase. The results of this first year's trial cannot be regarded with satisfaction. Even in view of the increases recorded by careful weighings, it was quite evident that the application of either of the fertilizers, when considered on this year's results, was not encouraging.

Table 31.

Number of Paired Plots.	Manure.	Mean Green Weight of Plot.	Significant (S) or Non-significant (N).	Estimated Weight of Hay per Acre.	Value of Hay per Acre.	Cost of Manure per Acre.	Profit or Loss compared with Unmanured Plot.
		lb.		T. cwt. qr.	£ s. d.	£ s. d.	£ s. d.
20	Basic slag ..	9.9	N	0 8 3	2 3 9	0 15 0	0 2 6 (loss)
20	Basic slag and lime	11.6	N	0 10 0	2 10 0	1 8 0	0 9 3 (loss)
20	Super ..	12.3	S	0 10 3	2 13 9	1 1 0	0 1 6 (gain)
20	Super and lime ..	13.4	S	0 11 3	2 18 9	1 14 0	0 6 6 (loss)
24	Lime ..	7.7	N	0 6 3	1 13 9	0 13 0	0 10 6 (loss)
..	Control ..	7.1	..	0 6 1	1 11 3	..	..

(37) R. THOMPSON, LAWRENCE.

The pasture on which this experiment was carried out is situated on the high rolling country above Lawrence. The paddock had been sown down about 1906 with a mixture of rye-grass, cocksfoot, and clover, but at the time of top-dressing (14th September, 1927) it had run mainly to brown-top and sweet vernal, with little or no clover. The plot was closed up on the 26th October, 1927, and during the growing-period observations were made, when it was noticed that patches of clover were coming back on the superphosphate strips. Owing to an unforeseen occurrence the plot was not harvested; therefore, treating the test purely from an observational point of view, superphosphate gave the best response. No striking differences due to lime were noted. The basic-slag strips did not show any increase over the control strips. This plot will be closed to stock, and cut and weighed, next season.

(38) J. CLARK, WAIRUNA.

This is a very interesting plot in a brown-top pasture situated on the flat country adjacent to Wairuna Siding. The pasture had been established about 1920 with a mixture of rye-grass, crested dogstail, and white clover. When the experiment was laid down the plot represented practically a straight-out brown-top sward, the clover growth being very weak and scarcely visible. The plot was top-dressed on 8th September, 1927, and closed to stock on 25th October, but was not harvested, so that what no doubt would have been interesting weighings had to be substituted by observations made during the growing-period. The plot was kept under close observation, and from early spring onwards strong clover-growth was noted on the superphosphate strips; slag also gave noticeable results, but not nearly to the same extent as super; crested dogstail also showed up most prominently on the manured strips. Arrangements are being made for the closing-up of this plot next season, when steps will be taken to have it harvested and weighed.

General Summary of Results.

The writers feel diffident in analysing the first year's results of the thirty-eight plots which have been dealt with, owing to the fact that

too hasty conclusions might be drawn by some farmers not conversant with the conditions under which the tests were conducted. It must be stressed that the experiments are only in their first year of operation, and the relative merits of the different fertilizers used must not be gauged on one season's work.

It is interesting, however, to summarize what has occurred during the first season as a result of the application of the various fertilizers. Of a total of thirty-eight plots, thirty-one were carefully weighed and seven were made the subject of close observation (these latter do not enter into the summary). The following points are illuminating:—

(1) In twenty-three plots superphosphate alone gave significant increases.

(2) In only eight plots basic slag alone gave significant increases.

(3) In four plots out of the thirty-one weighed lime gave significant increases.

(4) In twenty-three plots super and lime gave significant increases.

(5) In fifteen plots basic slag and lime gave significant increases.

(6) In eight plots no increase was derived from any treatment.

In the case of eighteen plots out of thirty-one, superphosphate and lime gave the highest yield over all treatments. In the case of five plots superphosphate alone gave the highest yield over all treatments. There is no question that during this first year's trial superphosphate gave the most satisfactory results, whether alone or in conjunction with lime. The differences in weights recorded throughout were invariably due to increases in clover content, and not to increases in general bulk of herbage.

The writers are much indebted to the various farmers who, by willing support and co-operation freely given, have materially assisted in bringing this first year's work to a successful conclusion.

ARROWTOWN FRUIT-TESTING PLOT.

IN 1913 a 1-acre co-operative fruit-testing plot was established on Mr. R. M. Patterson's Ayrburn Estate, Lake Hayes, near Arrowtown, in Central Otago, and was planted with a comprehensive selection of stone- and pip-fruit varieties. A recent report on the plot by Mr. W. R. Lloyd Williams, Orchard Instructor for the district, stated that among the apples Delicious, Swaar, Yellow Bellefleur, and Beauty of Bath appeared to be outstanding in vigour and cropping-capacity. Of the plums Lord Kitchener, Grand Duke, and Early Orleans were growing and cropping very well. Among the apricots Early Large Red and Gooley were doing well. The test has now been closed.

—*Horticulture Division.*

PIRIPIRI CONTROL: AN INSECT PARASITE.

AMONG the weeds the control of which is being studied at the Cawthron Institute piripiri (bidi-bidi) is placed with those of major importance. In the search for suitable insects to control this weed definite progress has been made through the discovery by Brother Claude Joseph, of Temuco, Chile, of a hymenopteron the larvæ of which feed upon the flowers of the Chilean species of *Acaena*.

On behalf of the Noxious Weeds Control Committee of the New Zealand Research Council, Brother Joseph is making a special study of this insect, and it is hoped that a consignment will be soon available for shipment to the Dominion, where it will be studied in quarantine at the Cawthron Institute.

The genus *Acaena*, to which piripiri belongs, is well distributed in Chile, where it is represented by some thirty species; but, though the burrs adhere to wool, the genus has not developed to the same extent as it has in New Zealand, nor is the damage caused by it so widespread. The hymenopteron now in question feeds on more than one species of *Acaena*, but so far is not known to attack any other genus of plants.

---David Miller, Cawthron Institute, Nelson.

IMPORTATION AND KEEPING OF WOOL RABBITS.

FOR some time past the question of permitting the importation of Angora and Chinchilla rabbits into New Zealand, and of allowing them to be kept and bred in the Dominion for the purpose of producing their wool for export, has been under official consideration. After going fully into the matter, the Government has decided to permit this under definite conditions, seeing that these rabbits are of a type unlikely to ever become a nuisance, even should any individual animals accidentally obtain their liberty. Moreover, their intrinsic value is sufficient to cause owners to take every precaution to prevent them getting away.

Before any such rabbits may be imported it is necessary to obtain a permit from the Minister of Internal Affairs. It must be clearly understood that such permit will be granted only conditionally on the importer undertaking to keep the animals always in close confinement to the satisfaction of the Government officers concerned, and also to fulfil the conditions laid down as to the procedure to be adopted prior to shipment. This procedure will include the provision of certificates of health, also observance of the precautions necessary to prevent the risk of foot-and-mouth disease infection being conveyed by material such as food, litter, &c., accompanying the animals. A shipping permit issued by the High Commissioner in London will be necessary before any shipments are made.

It is intended to deal with the matter legislatively during the present session of Parliament in connection with a measure consolidating and superseding the existing Rabbit Nuisance Act. Under this measure the Minister of Agriculture becomes the permit authority.

SEASONAL NOTES.

THE FARM.

LUCERNE-MANAGEMENT.

MANY promising stands of lucerne are injured by grazing the crop hard in the winter. Rye-grass, *Poa annua*, white clover, catsear, and rib-grass—all common weeds in lucerne—establish best on ground where there is a short turf and plenty of light. Cutting in late autumn and grazing during winter, when the lucerne is practically dormant, thus expose the stand to weed invasion. Lucerne-fields are best left over the winter with a fair growth on them to check weed-growth and keep the lucerne vigorous. Young stands especially are benefited by the late autumn growth being allowed to stand over the winter.

Lucerne will benefit in the early spring from a good cultivation with a tine cultivator, just before the crop starts vigorous growth. Cultivation at this stage checks the weed-growth, and stirs and aerates the soil, and then the vigorous growth of lucerne smothers out most of the weeds that are left. The cultivator should have tines with sharp points and stir the soil between the lucerne-plants, but the tines should not be fitted with wings which may injure the crowns of the plants. Disks are often used on lucerne-fields, but they are inclined to injure the crowns and thus allow the plants to be invaded by the spores of root-fungus.

Lucerne responds well to top-dressing with phosphatic fertilizers, and practically all stands will benefit from a spring application of 3 cwt. to 4 cwt. per acre of superphosphate or basic super.

Land intended for sowing lucerne should be ploughed during August, and the crop should preferably follow grass, when the soil will be at the highest state of fertility. Early ploughing is essential if the grass turf is to be properly decayed by the time the crop is sown. Lucerne does best on deep, friable, well-drained soils; land where the watertable is near the surface in the winter is quite unsuitable.

TILLAGE OPERATIONS.

August is a busy month on the arable farm. The sowing of spring cereals and the ploughing of land for spring and summer-sown root and forage crops will keep the teams or tractor busy on all days the land is fit to work. Normally the spring work can be lightened by making every endeavour to get the stubbles intended for root and forage crops turned over in the early winter, and grassland intended for turnips and rape should be ploughed if possible before the sowing of spring cereals. Early ploughing, besides increasing the amount of moisture held in the land for the use of crops, exposes the soil to the weathering agencies of the atmosphere, and the breaking-down of the soil under the influence of the weather will lessen the amount of cultivation work necessary in the spring to obtain a fine seed-bed.

In dairying districts of the North Island there is normally no imperative need for the early winter ploughing of grassland for root and forage crops, owing to the high rainfall experienced. The land should be broken up by the middle of August, so as to allow sufficient time for the grass-sod to rot before the crop is sown. On many of the lighter soils of Auckland Province the winter fallowing of grassland is often disastrous. In many places the pastures contain a good deal of brown-top, red-top, and *Poa pratensis*, and although these grasses may not be very noticeable in an old pasture before it is broken up, they are rejuvenated by ploughing and grow vigorously during the winter, when the land cannot be touched owing to the wet weather. Land on which these grasses are likely to be troublesome should never be winter-fallowed by skim-ploughing the lea in autumn or early winter, but should be ploughed in August with a skimmer attachment on the plough, and be kept worked up during the spring until the crop is sown.

INTENSIVE PASTURE-MANAGEMENT.

It is probable that much more intensive methods of farming grassland will be undertaken on dairy farms in the near future. Intensive grass-farming consists in close subdivision, regulated stocking, and heavy manuring. Grass is treated as a crop—the pasture being allowed to reach a height of 4 in. to 5 in., quickly grazed down, and then spelled until the next crop of young grass is ready. The seasonal growth of grass and the seasonal requirements of the dairy cow render the planning of a system of intensive grass-farming somewhat complicated. In adopting more intensive methods it would be desirable for a start to closely subdivide one half of the farm, and treat the grass on this area as a crop to be grazed always at the right stage; the remaining half could be used for grazing when the grass on the intensively farmed half was not ready, for the saving of hay and ensilage, and the growing of supplementary crops for periods of grass shortage. The grass of the whole farm would require top-dressing with phosphatic fertilizers as at the present time, but the grass-growth on the intensively farmed half would be stimulated by nitrogenous dressings in the late winter, the late spring, and autumn.

A question of particular interest at this period of the year is the efficacy of sulphate of ammonia for increasing the early spring growth of grass, and experiments to test the value of 1 cwt. per acre of this fertilizer applied in July are now under way. Most farmers now save some of the winter growth of grass for early spring, but this growth is usually finished by the middle of August, and there is a period of grass shortage from the middle of August to the middle of September that is difficult to fill. The efficacy of sulphate of ammonia in increasing the early spring growth will depend a good deal on the type of pasture top-dressed. The growth will be most vigorous on pastures that have been brought to the rye-grass standard by regular top-dressing with phosphates over a period of years.

—P. W. Smallfield, B.Ag., *Instructor in Agriculture, Auckland.*

THE ORCHARD.

LATE PRUNING OPERATIONS.

A REMINDER is given to orchardists who have not yet been able to complete their pruning to proceed with the work as quickly as possible, so as to get it finished before the trees start into growth for the new season. It is also advisable, if time permits, to examine the trees after pruning, especially with regard to the number of fruit-buds and spurs left on the trees. A superabundance of fruit-spurs usually means heavy blossoming, but not necessarily a heavy setting of fruit. In fact, the opposite is often the case; consequently a little extra time spent on the thinning of fruit-spurs is well worth while. Cox's Orange Pippin, Sturmer, and Delicious are varieties that are apt to stop in growth as the tree reaches maturity and heavy fruit-production commences. It is often found necessary to cut back two or three years' growth, eliminating all spurs and fruit-buds for a further 4 in. to 6 in. for the purpose of promoting growth and restoring vigour.

The destruction of all prunings as soon as pruning is finished will help considerably against the spread of disease in the orchard.

SPRAYING.

From now on till picking-time the spraying equipment will be in more or less constant use. To save time and inconvenience later in the season a thorough overhaul of the pump and engine should be given, examining all parts to see that everything is in good order. Hose should be tested and replaced where necessary, and a sufficient supply of spraying materials should be obtained. Where home-made lime-sulphur is used extensively a good supply should be made and barrelled for use throughout the season. Very few growers spray their trees during the dormant period, preferring to wait until the buds begin to swell in early spring, but it has to be admitted that a good spraying with red oil occasionally is very beneficial, especially where lime-sulphur sprayings have been given repeatedly over a number of years.

A knowledge of the pests and diseases affecting fruit-trees leads to more intelligent spraying, and thus helps considerably in control. A grower should be able to identify the different pests and diseases, to enable him to apply the proper solutions, whether for sucking-insects requiring a contact spray, chewing-insects requiring a poison spray, or fungoid diseases requiring a fungicide. The principal contact sprays for use against sucking-insects are lime-sulphur, red oil, and Black Leaf 40; poison sprays against chewers, arsenate of lead; and lime-sulphur, bordeaux and precipitated sulphurs for the control of fungus diseases.

Stone-fruits will in all probability be the first requiring spray, in order to cope with leaf-curl, shot-hole, and brown-rot, and to keep in check any San Jose scale or red mite that may be present. Bordeaux at strength 8-6-40, just before the buds begin to swell, will be found very effective against the spores of leaf-curl and shot-hole fungus. Another application in the early pink stage of blossom development at strength 3-4-40, should be given where necessary. For the control

of red mite and San Jose scale either red oil or lime-sulphur can be used at the semi-dormant period, driving the spray with sufficient force to penetrate every crevice where these pests usually congregate. Red oil, at strength 1-15 to 1-25 according to advance, will do good work. If lime-sulphur is used, a strength of 1-15 should be effective; this spray will also assist in the control of fungus diseases.

CULTIVATION AND MANURING.

The ploughing of the orchard should be taken in hand as soon as possible, burying all leaves and rubbish, &c., to avoid any chance of disease infection from this source. If the trees are hoed or dug round at this time of the year, much extra work will be saved later on, when the ground gets harder as the warm weather approaches. Soon after ploughing is finished, and before spraying starts, the orchard should be harrowed down, making it easier for the spray-machine to travel over the ground, and in some cases avoiding breakages. Where stationary spraying plants are used, the breaking down of the ploughed ground might be left till later, although it is much easier to drag a lengthy hose over an even surface than over furrows.

The good results obtained from the use of manure in the orchard will no doubt influence many growers in this respect. Liming may be done before the ploughing, other manures, such as superphosphate, basic slag, and bonedust, following slightly later and being harrowed in. Applied at this time of the year, better results will be obtained than later when warm weather sets in.

GENERAL.

Many of the older varieties of fruit-trees, proving unprofitable, are worked over every season, and the question naturally arises as to the best variety to substitute. Greater consideration is being given to the later varieties. Of these both Statesman and Granny Smith can be relied upon to give good results in the majority of districts, although the advice of the district Orchard Instructor as to suitability is recommended before any extensive reworking is done. Scions may be collected during the pruning season and stored in a cool damp place, preparatory to grafting during spring when the sap begins to move.

Wiring of the trees in the orchard should be given attention at this time of the year, when they are in a more or less upright position, making the operation much easier. Although the initial cost of wiring may be heavy, the advantages gained more than compensate for the outlay.

An examination of fruit in cool store should now be made, marketing any variety that is showing signs of wilting or rotting. In repacking from the store care should be taken to see that only good sound fruit is sent forward to market.

Planting of new areas can be proceeded with, providing the land is in suitable condition. If the land is inclined to be wet, the young trees should be heeled in until such time as the ground is fit for working. A small quantity of blood-and-bone manure applied when planting will assist the young trees very materially.

—G. Stratford, Orchard Instructor, Motueka.

Citrus-culture.

Routine work among citrus-trees in the coming month will consist of harvesting fruits as ready, attention to surface drains to take away surplus water, and the provision of light protection of scrim or brush-wood to young trees against frost. Shelter-belts may be trimmed, and new shelter planted as required.

Land should now be prepared for any new plantations. Good drainage is essential; unless this is natural—which is much to be desired—artificial underdrainage must be provided, or the trees may be expected to languish rather than thrive. A thorough working of the surface soil and first subsoil is also advisable, but this should be done uniformly over the whole area and to the same depth. One often finds that immediately under where the tree is to be planted the subsoil is dug to an extra depth when opening the hole for planting. This is bad practice, as it only encourages water to stagnate in the basin to the detriment of the tree. General surface levelling should also be done, filling in depressions which would be likely to hold surface water.

Special work of the month will be a general pruning of the trees to prepare them for the spring growth. At this season surplus branches on lemon-trees should be cut out, to allow light and air to penetrate generally throughout the tree. Lemons are carried on fruiting-wood right throughout the tree, and only when fruit laterals have space to develop can these be matured to advantage. Oranges are only found on annual fringe wood extensions; more of a globular bush habit is therefore desirable with them.

Towards the centre of lemon-trees can generally be found soft growths of a very woody nature; these are best suppressed, as they are rarely fruitful. Branches or laterals which cross should also be cut back, as bark chafe is decidedly injurious. In pruning the larger wood the work should be done in a way which will maintain and encourage the more horizontal wood—"pruning down," as it is termed by some growers. In a general way, the more upright the wood the less likelihood of good fruit-bearing laterals being formed. All cuts should be made clean by smoothing off the ragged edges with a knife after sawing, and the cut surface coated with coal-tar. Throughout the trees are to be found laterals which have carried fruit and become worn out; if really old and non-vegetative these should be cut away, but if young and in good vigour they may be cut back to a good bud, which may be expected to make a further lateral.

—W. H. Rice, Orchard Instructor, Auckland.

POULTRY-KEEPING.

HATCHING REMINDERS.

POULTRY-KEEPERS who have not commenced hatching-operations are reminded that August and September are the best months to have the chicks coming out; chicks brought out later seldom prove satisfactory. No time, therefore, should be lost in securing the required number of young birds for the season. In many cases, of course, hatching-operations will be delayed till October or even later,

owing to the inability to secure broody hens. But the poultry-keeper who is really anxious to secure highly profitable stock will not delay his hatching-operations by waiting for broody hens. He will adopt artificial methods, and thereby be able to have all his stock hatched out at the right time.

It is now recognized that the maximum returns cannot be secured from poultry unless late autumn and winter eggs are produced in good numbers. It is also recognized that the pullets must be chiefly depended upon to produce these, and to do so the chicks must be hatched by the end of September at latest. In a general way, this involves the adoption of artificial methods, as on most plants it is almost impossible to secure the desired number of broodies when they are required. Even on the general farm artificial means must be resorted to, either by using an incubator or by purchasing day-old chicks from a reliable breeder, and rearing these by means of an up-to-date brooder.

OVERDUE HATCHES.

The invariable cause of chicks not hatching on time is that the incubator has been maintained at too low a temperature. The thermometer may have been placed too high above the eggs, or it may not be accurate. If eggs do not pip up to time (say, at the twentieth day for hen-eggs and the twenty-sixth for duck-eggs) the only safe course to take, before the machine is again set, is to have the thermometer tested, and to see that it is hung in the correct position, the bulb being allowed to rest against the top surface of a fertile egg. Naturally an incorrect temperature may be secured from the reverse position through the thermometer being too far below the level of the tops of the eggs.

For hen or duck eggs the temperature at the level of the tops of the eggs on the tray should be about 102° F. the first week, 103° the second and third weeks, and 104° when hatching. There need be no alarm should the temperature vary slightly for an hour or two, but if longer than this, particularly during the early stages of the incubation process, the germ is apt to become impaired and the success of the hatch affected. When the correct degree of heat is spoken of this means the temperature required by the germ of the egg, which is always floating uppermost quite irrespective of the position of the egg. Of course, eggs that are stale always take longer to hatch than those which are fresh.

It will generally be found that really good hatches are obtained only when the hatchable eggs pip and hatch about the due time, and in the case of hen-eggs when all the available chicks are out of the shell on the twenty-first day. Thus, if the breeding-stock are in proper condition, the eggs fairly fresh, the thermometer kept on a level with the germs, and even then the hatch is delayed, it is, as before indicated, as well to have the thermometer tested or a new one obtained.

One little point may be mentioned in regard to duck-eggs. While these usually commence to pip on the twenty-sixth day, they do not hatch out until the twenty-eighth day. Therefore, do not open the machine or attempt to assist the young birds out of the shell until they have at least had their full time to hatch.

How to Test a Thermometer.—Place a clinical thermometer and the one to be tested in water at 100° F; stir gently, adding slowly at the same time hot water; and observe the different readings. If the incubator instrument reads, say, a degree lower or higher than the clinical, it must be worked a degree higher or lower accordingly.

DETERMINATION OF AGE OF DUCKS.

A correspondent wants to know how to definitely tell the age of a duck. So far as the present writer is aware, there is no means by which this can be ascertained. The condition of the windpipe, however, is a good guide as to whether or not a bird is an old or a young one. If the windpipe is hard to the touch, it is safe to say the bird has passed the duckling stage. On the other hand, if the windpipe is soft and yielding to the touch it indicates that the bird is comparatively young. In applying this test with a live bird care must be taken that the windpipe is not squeezed to the extent of injuring the bird. With a dead duck the condition of the upper part of the bill gives a good indication as to its age. In a young bird the bill can be pressed back and easily broken, while with an old one this will be found a difficult matter unless great pressure is used. Another way of deciding between an old and a young bird is the manner in which the breast-bone can be pierced with, say, a sharp hat-pin. With a young bird the bone can be pierced with but little pressure, but in the case of an old one the reverse is the case.

THE SITTING HEN.

A matter for first consideration when setting a hen is whether she is free from insect pests. The hen should be well dusted with an insect-powder before being entrusted with the eggs, and again prior to hatching. On no account should she be dusted when the chicks are very young, as the powder is apt to get into their eyes and cause blindness. Not only should the hen be free from vermin, but care must also be taken that the coop is free from red mite. The hen should be isolated from the poultry-house, as few houses are as free from vermin as they might be. Another advantage of keeping the sitting hen away from the poultry-house is that she will not be disturbed by other members of the flock. The presence of vermin and continued disturbance by other fowls are the most common causes of hens leaving their nests before hatching takes place. The hen will usually sit better if the nest is made in a rather dark place. A common practice is to set a hen in a confined box where she must be necessarily let off once a day to feed and drink, as well as for the purpose of keeping the nest clean. It is, however, a much better plan to set the hen in a coop with a roomy run attached. She can then have before her at all times all she requires in the way of food and water, and can leave and return to the nest as she pleases.

When setting a hen the great aim should be to follow nature as closely as possible, and yet have the hen under control. To achieve this end, and to guard against the chicks being carried away by cats, stoats, or weasels, the best and cheapest course in the long run, as already indicated, is to provide a proper coop and run for the mother hen and her brood. It is always advisable to make the coop in such

a way that it can be easily moved to fresh ground. It should be rat-proof, while the run should also protect the little birds from their natural enemies.

The run should not be made too small. If the chicks are to develop into robust stock they should have ample room to scratch and exercise. It is always a wise plan to have a floor to the coop, unless, of course, it is under cover, so that the birds may not be swamped out during wet weather. When making the nest place 3 in. or 4 in. of moist earth in one corner of the coop. The earth may be kept in place by means of four bricks. Shape the nest so that the eggs will have a slight tendency to roll to the centre, care being taken to see that it is roomy and flat in the centre. This will allow the hen the necessary room to turn the eggs, which she does several times a day. The nesting-material may consist of dry grass, hay, or fine straw. A good plan is to first put the hen on a few china eggs until satisfied that she can be entrusted with the eggs intended for hatching.

When the hatch is completed the hen may be given a feed of grain, preferably out of a tin or something similar, but there is no hurry to feed the chicks for at least twenty-four hours. The egg-shells should be removed and the nest made comfortable, one of the bricks being also taken away, so that if a chick jumps out of the nest it may easily return to it. Many chicks are drowned by jumping into deep water-vessels, and this risk should be minimized by using a shallow water-tray.

The food for sitting-hens should consist of whole grains, maize being included when available. This, with grit and clean water, is all that is required. Mashies, meat, and green food are apt to slacken the bowels and cause the eggs to be soiled, to the detriment of the hatch.

—F. C. Brown, *Chief Poultry Instructor, Wellington.*

THE APIARY.

WINTER CONDITIONS.

As indicated last month, there is little a beekeeper can do for the welfare of his bees at this period beyond examining the hives for leaky covers and damp mats. If any are found in this condition they should be replaced. All manipulations of the bees should cease, and the bees, having been made as snug as possible, left until the arrival of the warm spring days.

LOCATING AN APIARY.

As the supply of grass and clover regulates the amount of stock carried on a given area, so does the same condition apply to what might be termed the grazing of bees. Unrestrained and at liberty, the bees fly where their desire prompts them, even to a distance of three or four miles from their home; but this is not necessary if a suitable site has been chosen. Rich land where clover grows abundantly and little cultivation is done is more suitable for bee-keeping than any other kind; and land of this description may be found in any dairying or bullock-fattening district. Sheep-grazing land is usually eaten

too bare, yet occasionally I have heard of good flows of nectar from valleys in such areas. Plenty of willows scattered over good country add materially to the value of a district in supplying early spring bee-feed; while a patch of native bush close by would also be advantageous in this respect. Catsear is also valuable as a nectar-producing plant, the honey being of an amber colour, smooth-grained, and of good flavour. After clover has finished blooming, thistles, if in any quantity, may be expected to furnish an excellent honey of a white colour, and this, blended with clover and catsear, forms a very fine product, and always commands the highest price.

SHELTER.

Next to selecting a good locality, arranging for good shelter is the most important matter. The formation of the neighbouring ground would perhaps assist in this respect. If there is any choice, select a low, well-drained spot, which will enable the bees to fly down when loaded for home. Such a position will also lend itself more readily to being sheltered. It is preferable to make use of natural shelter, if handy, providing the trees are not too large to cause a draught; where there is open country I would advise putting up a temporary fence of boards or brushwood on the sides of the prevailing winds until a substantial green fence has grown. Tagasaste (*Cytisus proliferus*), sometimes called "tree-lucerne," grows very rapidly, and makes a good shelter in two seasons. It should be planted about 2 ft. 6 in. apart, and the ground round the roots kept free from weeds. It stands a great amount of cutting, and flowers along the branches very early in spring, thus forming a very welcome addition to other early honey-producing plants.

Bees should not be placed too close under big trees or immediately under hedges, or in any damp place, for under these conditions they become irritable and the combs are liable to get mouldy. Bees require shelter, but at the same time plenty of sunlight.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

TOBACCO-CULTURE.

THOSE who are making experimental plantings of tobacco have now to consider the details of sowing and raising the seedlings. This may be done in shallow trays $2\frac{1}{2}$ in. to 3 in. deep. If trays made from petrol-tins are used, holes should be made in the bottom to allow for drainage. The soil should be a mixture of three parts good fresh loam and one part well-rotted manure. A little bonedust, and sufficient sharp sand to keep the soil from setting hard or forming a crust, should be added. Place the more fibrous portions of the compost in the bottom of the tray, then fill it up, and press the soil down firm with a small piece of board, so that the surface is level and half an inch or so below the edge of the tray.

Sow the seed thinly and press it into the soil. If any covering is given it should be of the lightest description, and is best applied

by shaking the soil or sand through a fine sieve. If the soil is on the dry side, water it before sowing and allow all stickiness to dry off before that is done. A sheet of glass placed over the trays will prevent excessive evaporation, which is an advantage, as it is important that the soil should not be allowed to become dry at this stage, and because of the difficulty of watering without disturbing the seed. Shading is also beneficial at this stage, and it may be done by covering the glass with a sheet of paper.

The most suitable place for such trays of tobacco and other half-hardy seedlings at this season is in a cold frame on a hotbed. A hotbed may be made of fallen leaves from deciduous trees or strawy stable manure, or both together. The material is brought into condition by setting up a steady fermentation throughout the whole mass, thus causing it to heat. The temperature is increased and the period extended according to the size of the bed. For this purpose comparatively fresh material is required, and it should be placed in a compact heap. In four to five days it will be very hot, and should be shaken out and restacked, meanwhile watering with a sprinkler any portions that are dry. This has the effect of steadying the heat, making it more general and lasting. After a similar interval this operation may have to be repeated. When it has heated up after the last turning the bed should be carefully stacked, meanwhile treading it firm. A height of 2 ft. to 3 ft. makes a good hotbed, and if the frame is to be placed on top the bed should be 1 ft. wider and longer than the frame. In warmer districts it is found sufficient if the fermenting material is placed in the frame to a depth of 1 ft. to 2 ft. After stacking, leave the bed for three to four days, then water it well, and place the glass sashes on and it is ready for use. As this preparation will take about a fortnight, it should be commenced in ample time before the period of sowing the seed.

A careful watch must be kept to see that the temperature in the frame after the seeds are sown is not allowed to become excessively high, or on frosty nights to fall too low. From 55° to 60° F. is a very good mean, and steps should be taken to cover or ventilate the frame if there is a tendency for either to be exceeded. Such a bed should, of course, be made in a well-drained location that is warm and well sheltered.

TOMATOES, CHILIS, EGG-PLANTS, ETC.

Tomatoes, capsicums (chilis), egg-plants (aubergines), Cape gooseberry, and other half-hardy plants may be raised from seed on a hotbed similar to that described above. In the northern and warmer districts it will be generally suitable to start them towards the end of August. Chili and egg plants are rather more tender than others of the class, and should be started and planted out two to three weeks later. These should be ready for planting out from the end of October to the middle of November. The plants should be raised clean and sturdy, but not before they may be planted outside. If raised too soon, and they have to remain in the boxes till the weather is suitable for planting them out, they receive a check that is injurious, especially to the early and more valuable portion of the crop.

Under glass it is now time to apply such fertilizers as may be necessary, and to complete the preparation of the soil for setting out the tomato-plants towards the end of the month. Houses that have been neglected sometimes have the soil in an overdry condition, and it requires a good soaking some time before planting. This should be carefully considered, as such a saturation is apt to check the plants if applied soon after planting. If the land is in a suitable moist condition before planting comparatively small quantities of water will be required during the cooler weather, and there is less risk of chilling the plants. The method of planting in shallow furrows has much to recommend it; it facilitates watering at this period, and as the furrows gradually fill in it increases the rooting system. After planting, the ventilation of the houses needs very careful attention; it is easy and very usual to give too much at this season. Avoid draughts and extremes of temperature; 55° to 65° F. is best. Close the houses in the middle of the afternoon while they are on the warm side.

BUSH FRUITS.

Where plantings of bush fruits are to be made it should be done on the first occasion the land is in condition. Gooseberries and red currants, requiring plenty of sun and air, should be planted 5 ft. to 6 ft. apart both ways. Black currants have a very different character, and are best planted closer in the rows; 3 ft. is not too close for most varieties. Raspberries are no doubt best planted singly 1 ft. apart and 5 ft. to 6 ft. between the rows. Plant firmly and prune the plants well back to induce vigorous growth and quick establishment.

VEGETABLES FOR MARKET.

Correspondence received shows that greater interest is being taken in the celery and asparagus crops. They require a good deep friable soil that is moist but well drained. Other soils can be made more or less suitable, but for commercial purposes a naturally suitable soil is necessary if costs are to be kept down and best results obtained. Celery is in greatest demand during the winter months, and for that market it should be planted out in the month of January, necessitating the sowing down of seed-beds about the month of October. For commercial production there appears no reason why the American method should not be successful here—that is, to plant 8 in. to 9 in. apart in shallow furrows, $3\frac{1}{2}$ ft. to 4 ft. apart, and earthed up for purposes of blanching. The seeds are sown in beds outside and grown under shade, while eight to ten days before the plants are lifted for planting out they are wrenched—that is, the tap roots are cut to facilitate removal. The plants in the beds must be kept moist and clean. The latter point is very essential, and at least two applications of bordeaux, 4-4-40, should be given before the plants are lifted.

Asparagus is a permanent crop which requires a well-sheltered situation. Seeds sown now will produce roots for planting out twelve months hence. Sow the seeds 1 in. deep in rows 15 in. apart, and when 3 in. high thin them to 4 in. to 5 in. apart. A sowing of 5 lb. of seed should produce sufficient plants for an acre of land. If the sowing is delayed the growing season is shortened, and the plants will be

comparatively small. Germination of the seed, which is naturally rather slow, may be hastened by soaking it in warm water for twenty-four hours. This treatment will facilitate weeding.

In addition to the seeds mentioned in last month's notes (which may still be sown) sow main crop onions, turnip-rooted beet, early carrots, parsnips, parsley, radish, and early turnips. Sow thinly, and so reduce the labour of thinning the plants and wasting the seed.

PLANTING OF TREES AND SHRUBS.

Where it is intended to plant hedges, and shelter, shade, ornamental, or fruit-trees, or nuts, the work should now be done at the very first opportunity, as if deferred there will be a risk of a higher proportion of losses. However, the trees should not be planted if the ground is not prepared nor the planting well planned; it is far better to defer planting till another season than do such permanent work hastily. Take the usual precautions and plant very firmly. Most plants of any size will require to be cut back rather severely to compensate for the loss of roots. The exception is chiefly in the case of conifers, but even with them a little judicious pruning is advisable if the plants are of any size.

LAWNS AND GREENS.

New lawns or alterations to old ones should be sown down or turfed without further delay. If bare patches in playing-greens are turfed now with grasses of the right kind a good even sward will be very quickly established. Old lawns will derive great benefit from a dressing now of sulphate of ammonia, at the rate of 1 oz. to 2 oz. to the square yard. With careful cutting and treatment with a light roller a good surface should be obtained.

—*W. C. Hyde, Horticulturist, Wellington.*

INTERIM RETURN OF SHEEP AT 30th APRIL, 1928.

Sheep District.	Number of Sheep.		
	Final Return, 1927.	Interim Return, 1928.	Difference.
Auckland	2,289,488	2,374,512	+ 85,024
Gisborne - Hawke's Bay ..	6,317,884	6,508,028	+190,144
Wellington - West Coast ..	5,350,448	5,546,421	+195,973
North Island totals ..	13,957,820	14,428,961	+471,141
Marlborough-Nelson-Westland ..	1,369,648	1,351,185	- 18,463
Canterbury-Kaikoura ..	5,102,411	5,505,442	+403,031
Otago (including Southland) ..	5,219,137	5,715,648	-496,511
South Island totals ..	11,691,196	12,572,275	+881,079
Dominion totals ..	25,649,016	27,001,236	+1,352,220

TESTING OF PUREBRED DAIRY COWS.

C.O.R. LIST FOR JANUARY TO JUNE, 1928.

Dairy Division.

THE half-year covered by the appended list is the quieter period of the C.O.R. system, owing to the comparatively small number of dairy cows in this country which are timed to calve between New Year and June. It will be noted that a number of meritorious performances are included in the forty-five records comprising the list.

LIST OF RECORDS.

*Cow milked three times daily during whole lactation period. † Milked three times daily during part of period.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
JERSEYS.						
Junior Two-year-old.						
		Yrs. dws.	lb.	lb.	lb.	
Te Aute Clementine ..	W. T. Williams, Pukehou ..	2 22	242.7	363	8,673.7	484.57
Conandale Royal Flush ..	S. Dale, Fairlie ..	1 288	240.5	365	6,551.8	412.13
Brookley Fairy ..	E. W. Jacobs, Horotiu ..	1 210	240.5	365	6,755.0	392.10
Jersey Nook Tui ..	R. C. Leach, Woodville ..	2 18	242.3	365	6,237.1	378.11
Okauia Leaflet ..	R. K. Garland, Okauia ..	1 200	240.5	311	7,157.3	370.19
Balla Mona Tiki ..	J. Hunt, Richmond ..	1 306	240.5	365	8,465.9	368.94
Kia Ora Lodestar ..	R. E. Clements, Dargaville..	1 350	240.5	257	5,458.0	303.36
Senior Two-year-old.						
Riverside Royal Gem ..	J. T. Belcher, Cardiff ..	2 124	252.0	365	8,655.6	490.02
Corra Lynn Miss Swan ..	A. Best, Bombay ..	2 359	270.4	365	8,417.0	440.40
Lisbury Lalabelle ..	F. Jennings, Mauriceville ..	2 105	257.0	365	7,772.1	422.27
Holly Oak Comedy Queen ..	L. A. McDonald, Levin ..	2 253	205.8	273	7,333.9	417.84
Majesty's Brilliant ..	G. Hodgson, Whakapara ..	2 272	207.7	314	6,940.4	414.67
Three-year-old.						
War Bride of Puketapu ..	T. H. Western, Bell Block..	3 135	200.5	365	10,961.7	679.61
Riverside Bangle ..	J. T. Belcher, Cardiff ..	3 35	280.5	365	8,636.3	487.18
Analysis ..	Mrs. I. W. Speirs, Levin ..	3 170	204.0	325	6,940.0	399.94
Okauia Lucille ..	R. K. Garland, Okauia ..	3 245	301.5	364	5,861.3	338.45
Four-year-old.						
Willow Bank Rose ..	J. T. Belcher, Cardiff ..	4 20	310.1	365	10,008.0	517.29
Momona Mahuika ..	Mrs. I. W. Speirs, Levin ..	4 235	337.0	365	9,699.9	405.13
Hui Mai Vanity ..	Mrs. I. W. Speirs, Levin ..	4 230	338.5	362	8,833.6	445.49
Mature.						
Holly Oak Merry Moments ..	John Hale, New Plymouth..	6 14	350.0	365	11,538.9	665.24
Marchioness Patricia ..	J. C. Hodgson, Whakapara ..	5 91	350.0	365	13,739.5	656.13
Elf's La Primevere ..	John Robb, Westmere ..	5 118	350.0	365	10,324.7	626.28
Housemaid ..	H. J. Lancaster, Glen Oroua ..	9 125	350.0	354	10,162.4	553.60
Tikihuna ..	F. S. McRae, Palmerston N. ..	7 237	350.0	365	9,034.4	524.27
Mauriaena Fairy ..	C. G. Aickin, Auckland ..	6 11	350.0	365	9,405.1	517.97
Richwood Rose ..	C. G. Aickin, Auckland ..	8 264	350.0	363	8,630.3	426.12

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
FRIESIANS.						
<i>Junior Two-year-old.</i>		Yrs. dys.	lb.		lb.	lb.
Hobson Alcartra Pontiac†	Hobson Farm, Ltd., Wharepapa	2 116	252.1	364	10,971.1	370.12
Totara Pontiac Maud*	Piri Land Co., Auckland ..	2 150	255.5	210	9,550.4	328.18
<i>Junior Three-year-old.</i>						
Ohio Sensation* ..	C. H. Potter, Pukerau ..	3 8	277.8	365	16,427.8	590.21
Totara K. P. Winnie Winthrop*	Piri Land Co., Auckland ..	3 101	287.1	365	15,936.0	561.05
<i>Senior Three-year-old.</i>						
Rosevale Sylvia Burkeyje*	North and Sons, Omimi ..	3 263	303.3	365	15,355.8	619.39
Pareora Butter Girl Cadillac*	A. S. Elworthy, Timaru ..	3 194	296.4	365	15,538.0	597.63
<i>Junior Four-year-old.</i>						
Rosevale Gipsy Abberkerk Posch*	North and Sons, Omimi ..	4 155	329.0	365	22,086.6	703.41
<i>Mature.</i>						
Rosevale Gladys Posch*	North and Sons, Omimi ..	8 24	350.0	365	28,555.2	940.43
Pareora Queen Ailsa*	A. S. Elworthy, Timaru ..	5 64	350.0	365	16,413.5	678.49
Muriel Mercena of Edingwood†	Piri Land Co., Auckland ..	5 151	350.0	365	16,886.5	607.08
Ryvington Pontiac Stately†	T. O. Hodgson, Tamahere ..	5 27	350.0	365	15,497.5	582.58
Rosevale Helena Keyes*	McDonald and Co., Waitati ..	6 42	350.0	365	14,944.0	469.62
Second-class Certificates.						
Jerseys.						
<i>Senior Two-year-old.</i>						
Kelvin Bright Eyes ..	G. Buchanan, Paeroa ..	2 290	269.5	333	5,976.9	299.78
<i>Four-year-old.</i>						
Over Proof ..	W. A. Burgess, Ruawai ..	4 20	315.5	363	6,541.9	367.64
<i>Mature.</i>						
Holly Oak's Princess*	Late W. T. Williams, Pukehou ..	7 12	350.0	365	14,430.9	681.30
Rewarder's Bella ..	G. Taylor, Ngarua ..	8 24	350.0	365	6,928.5	409.17
Friesians.						
<i>Senior Two-year-old.</i>						
Rosevale Korn dyke Queen	North and Sons, Omimi ..	2 289	269.4	365	19,502.0	669.66
<i>Mature.</i>						
Wyuna Rose† ..	A. G. Wood, Tikorangi ..	8 8	350.0	364	22,439.3	769.65
Ayrshires.						
<i>Mature.</i>						
Maesgwyn Maire ..	C. M. Williams, Kaiapoi ..	6 57	350.0	365	16,419.9	638.80

REVIEW.

Plant Hunting. By ERNEST H. WILSON, M.A., V.M.H., Keeper of the Arnold Arboretum of Harvard University. Two volumes; xxix plus 275 pages, with 128 illustrations. The Stratford Company, Boston, Mass., 1927.

To that large majority who love gardens this delightful book will be brimful of interest, nor will it, when once begun, be readily laid aside until read from cover to cover. But the circle of its readers will be wider still, since it appeals to all who care for descriptive geography, for the characteristic plants of different lands are a distinguishing mark equally with their inhabitants and their languages.

Assuredly the flower-garden is one of the greatest amenities of civilized life, but we are generally content to leave it at that, and to give no thought as to the origin of its brilliant or fragrant tenants. Yet usually few of these are native to the soil, but have been brought from many lands, the world at large from seashore to alpine heights having been ransacked. Indeed, they represent the untiring and self-sacrificing labours of that intrepid band of pioneers—the “plant-hunters,” the names of many of whom (mostly forgotten) and their worthy deeds are set forth in this book by the author—himself one of the foremost of them, and probably the very foremost. Who now, for instance, when preparing his chrysanthemums for the local show or admiring his bushes of azaleas with their glistening blossoms gives a thought to Robert Fortune, who first brought them and many other famous Chinese plants to Britain, and with his introduction of the tea-plant to India laid the foundation of a great industry? Or how many among us have ever heard of Francis Masson—“pioneer and forerunner of the many plant-collectors sent out from the famous Kew Gardens”—who reached South Africa in 1772? Yet to him we owe the beautiful and quaint green ixia and many other bulbs with brilliant flowers.

These labours of the plant-hunters are arduous enough, and frequently have more than a suspicion of danger. Thus the author, speaking of his experiences in Formosa—“Pearl of the Orient,” he styles it—soliloquizes, “Well, if they take a fancy for my head during the night I do not see what is to prevent them from taking it.” And he proceeds, “Gathered around several fires were two score half-naked ex-head-hunters armed with bows and arrows, long knives and guns.” But consider the reward to the lover of nature when he gazes on natural gardens never seen before by civilized man. Writing of his experiences in “that remote hinterland which separates western China and the Thibetan Plateau” the author says, “To picture these alpine regions during the short summer that is theirs, one must visualize mile upon mile of colour spuming like foam about a storm-tossed shore—seas of yellow, red, orange, blue, violet, and purple. From sun-kissed snows of dazzling whiteness, treacherous glaciers, and hummocked moraines, downward stretch green grassy areas decked with a million flowers of every hue.” Then of the Sikkim cowslip—a plant readily cultivated in New Zealand wherever our true alpine plants can be grown—he tells us that “In moist meadows, and by the sides of streams and ponds, it occurs in thousands and hundreds of thousands, like cowslips in an English meadow. On many a plant may be counted twenty scapes, each with large umbels of flowers filling the air around with soft delicious odour.”

The floral gems of many countries are described: for instance, those of the tropics, where one revels in “Natures luxurious extravagance”; the Orient—“Mother of gardens whose bounteous crops enrich the world”; Korea—“Land of the morning calm”; Japan—“Land of the Rising Sun”; and South and Central Africa—“Sunlit lands whence came Gladiolus and a thousand other familiar plants that gladden lives with their beauty.”

To us here the 150 pages devoted to Australia and our own country must be of special interest. Though these regions are so close, their vegetation and plants bear hardly any resemblance, and our flora of some 1,800 species looks rather small as compared with the 10,700 species of Australia. Also, as the author explains, New Zealand possesses no species of the

dominant types of Australia—e.g., "Eucalyptus, Acacia, Grass-tree, Banksia, Melaleuca, Casuarina, Callitris, nor Cycad." All the same, the author has a very warm place in his heart for New Zealand—"Queen of the Southern Seas," as he calls her—and he devotes no less than three chapters to the flora and the vegetation. "Green, intense green," he declares, "is the keynote of New Zealand." And, of course, he pays a tribute to our ferns, of which he truly says, "Forty genera in 140 species grow there, but these figures give no adequate idea of the real richness of New Zealand's fern-flora." At the head of all our trees and shrubs for garden purposes he places the mountain-ribbonwood, *Gaya Lyallii* (its present name is *Hoheria glabrata*, the third time the name has been altered), but he explains it is too tender for the great garden over which he rules, as are, in fact, all New Zealand trees and shrubs. Many of the genera come under review, and the importance of their species for gardens is emphasized; in short, a necessarily brief but trustworthy account is given of New Zealand plant-life, and its salient features are stressed.

In addition to the author's botanical treatment of the Dominion, he deals with other matters, giving, for instance, much praise to its scenery—and he is surely a qualified judge. And, to turn to a quite different subject, the following statement must find a place here. "Of the fragrant recollections I retain of New Zealand none is pleasanter than that of the mutual respect I found among whites and Maoris one for the other. There, at least, alien races live together in amity and good fellowship, equal in political status, tolerant and neighbourly toward each other."

A book so informative and dealing with matters of interest and importance to the whole community should be in all our reference libraries and in the circulating libraries of the large towns. It also contains exactly that measure of plant geography suitable for these seeking to obtain the Diploma of the New Zealand Institute of Horticulture.

L. COCKAYNE.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 17th May to 12th July, 1928, include the following of agricultural interest:—

No. 57652: Cheese-disk follower; W. A. McDonald, Wyndham. No. 57838: Hay-sweep; J. I. Carter, Waipawa and J. Hyslop, Hawera. No. 58607: Fertilizer; Imperial Chemical Industries, Ltd., London. No. 60282: Farm tractor; C. Murnane, Melbourne, Vic. No. 60283: Machine for gathering subterranean clover; F. S. Hill, Cobden, Vic. No. 60379: Cleaning cereals; Henry Simon (Aust.), Ltd., Sydney, N.S.W. No. 58488: Wire-strainer; A. A. Baker, Ngaruawahia. No. 58510: Milking-machine installation; D. M. Wallace, Te Aroha. No. 58547: Milking-machine installation; B. Waterson, Apiti. No. 58897: Manure-sower; A. J. Redding, Midhurst. No. 59800: Milking-machine claw; T. P. Hackett, Momoma. No. 60261: Separating seed; J. N. Mitchell, Sydney, N.S.W. No. 60270: Sheep-dip race; J. T. Coddington, Cuningbar, N.S.W. No. 60340: Cream-separator; D. M. Wallace, Ltd., Te Aroha. No. 60341: Milk-strainer; D. M. Wallace, Ltd., Te Aroha. No. 60444: Sheep-shearing machine comb-plate; R. A. Lister and Co., Ltd., Dursley, Eng. No. 58633: Bag-lifter; T. McFadden, New Brighton. No. 59051: milk-pasteurization; A. H. Templeton, Dunedin. No. 60402: Animal drinking-fountain; G. Allman and S. B. Hemming, Parkerville, W. Aust. No. 57688: Scarifier; E. W. Poole, Dannevirke. No. 58835: Hedge-cutting machine; C. Collett, Invercargill. No. 59868: Weed-destroyer; H. W. de Castro, Wellington. No. 60180: Manure-sower; H. T. Lowry, Patumahoe. No. 60327: Pig-snout-cartilage cutting; A. P. Horne, Buckland. No. 60565: Potato-picker; P. Dahlman, Grandy, Minnesota, U.S.A.

Copy of full specifications and drawings in respect of any of the above may be obtained from the Registrar of Patents, Wellington, price 1s. All fees must be paid in advance in cash, or paid to the Public Account at a branch of the Bank of New Zealand and the bank receipt sent to the Patent Office; or fees may be remitted by Post Office order or postal note.

WEATHER RECORDS: JUNE, 1928.

Dominion Meteorological Office.

GENERAL NOTES.

JUNE was a wintry month, with a marked predominance of cold south-west or southerly winds. Temperatures were below normal in many parts, but, except in the southern portions of the South Island, frosts were not particularly numerous or severe. The majority of the strong winds blew along the length of the Islands, with intermittent shiftings to a more southerly or south-easterly direction. Their force was therefore felt mainly in the northern and southern extremities of the country and in the surrounding ocean waters, with occasional visitations on parts of the east coast. The parts exposed to the winds received more than their usual quota of rainfall for the month. The Bay of Plenty, Waikato, Taranaki, Wanganui, Marlborough, Nelson, and Westland districts, and the interior of the South Island, however, had less than the average, the deficiency amounting to as much as 70 per cent. in some cases. Nelson and Taranaki experienced particularly fine weather.

The storms which occurred during the month were mainly of the cyclonic variety, four principal ones being recorded. Westerly winds were again conspicuous by their absence. The cyclone centres all passed north of Cook Strait. Three of them were responsible for stormy conditions over the whole of the Dominion. Of these the first passed Cape Maria Van Diemen on the 10th, and subsequently moved in a south-south-east direction past the Chatham Islands. Southerly gales and general rains were experienced on the 11th and 12th. During the approach of the storm between the 7th and 9th pressure was high to the east of New Zealand.

On the 14th and 15th, while a moderate anticyclone was covering New Zealand, an intense cyclone developed off the coast of New South Wales. Moving slowly eastward, the centre passed through Cook Strait on the 18th. From the 15th to the 21st the weather was almost continuously dull and unsettled, with more or less rain. On the 18th the rain was general, and there were fairly widespread falls of snow in the South Island and the central parts of the North Island. North-easterly gales blew in the North on the 15th and 16th, and fairly general southerly gales from the 18th to the 21st. On the 21st there were again extensive falls of snow, while hail was reported in many places.

The last cyclone appeared between Cape Maria Van Diemen and Norfolk Island on the 26th, causing northerly gales in North Auckland. Moving south-eastwards and intensifying, this disturbance caused strong south-westerly winds to gales and much rain in the last three days of the month. There was a lull, however, on the night of the 28th during the development of a secondary depression. This was followed on the 29th by the third fall of snow for the month in parts of Canterbury and Otago, some of it even reaching the Plains country. Hail, also, was experienced at some stations. Auckland Province suffered worst from this storm, the northern portion experiencing north-easterly gales during its approach, while westerly and southerly gales were more general in its rear. Considerable damage was done to telegraph-wires, trees, and even buildings. Some damage was done, also, by the southerlies in the South Island, especially Southland.

—Edward Kidson, Director of Meteorological Services.

RAINFALL FOR JUNE, 1928, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall	Average June Rainfall.
<i>North Island.</i>					
		Inches.		Inches.	Inches.
1	Kaitaia	10.25	18	2.14	3.53
2	Russell	8.70	12	2.28	7.15
3	Whangarei	12.67	19	2.72	6.22
4	Auckland	5.84	22	1.40	4.91
5	Hamilton.. ..	3.22	16	0.47	5.19

RAINFALL FOR JUNE, 1928—continued.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average June Rainfall.
<i>North Island—continued.</i>					
		Inches.		Inches.	Inches.
6	Kawhia	3.10	16	0.38	5.72
7	New Plymouth	3.71	17	0.89	6.14
8	Riversdale, Inglewood	5.42	17	0.97	10.31
9	Whangamomona	3.70	10	0.57	7.62
10	Eltham	4.87	16	0.85	5.46
11	Tairua	6.30	13	1.58	7.38
12	Tauranga	4.73	12	2.18	5.42
13	Maraekaho Station, Opotiki	1.86	8	0.72	5.99
14	Gisborne	6.15	17	1.52	5.28
15	Taupo	1.27	5	0.60	4.48
16	Napier	2.05	17	0.49	3.59
17	Maraekakaho Stn., Hastings	3.51	21	1.26	3.35
18	Taihape	3.02	18	0.64	3.85
19	Masterton	4.48	19	1.14	3.48
20	Patea	3.40	13	0.80	4.15
21	Wanganui	3.02	10	0.60	3.19
22	Foxton	2.22	10	0.68	2.96
23	Wellington (Karori Reservoir)	5.66	18	1.31	4.63
<i>South Island.</i>					
24	Westport	4.78	18	0.92	7.53
25	Greymouth	4.99	14	1.24	8.27
26	Hokitika	4.43	14	0.92	9.60
27	Ross	5.51	11	1.68	9.20
28	Arthur's Pass	3.45	13	1.00	10.12
29	Okuru, Westland	4.89	5	2.00	10.76
30	Collingwood	3.76	15	0.91	11.33
31	Nelson	1.58	6	0.97	3.69
32	Spring Creek, Blenheim	2.22	4	1.40	3.01
33	Tophouse	2.66	11	0.80	4.75
34	Hanmer Springs	4.22	17	0.83	3.11
35	Highfield, Waiau	2.40	9	0.70	2.49
36	Gore Bay	6.24	15	1.98	2.34
37	Christchurch	4.83	20	1.78	2.66
38	Timaru	2.01	11	1.10	1.70
39	Lambrook Station, Fairlie	1.50	7	0.64	1.91
40	Benmore Station, Clearburn	0.54	15	0.16	1.90
41	Oamaru	1.14	9	0.48	2.01
42	Queenstown	0.57	4	0.29	2.46
43	Clyde	0.28	5	0.08	0.98
44	Dunedin	1.65	12	0.59	3.15
45	Wendon	2.50	12	0.47	2.42
46	Gore	2.94	19	0.48	2.82
47	Invercargill	5.03	20	1.08	3.60
48	Puysegur Point	7.22	21	0.89	6.58
49	Half-moon Bay, Stewart Is.	3.89	20	0.49	4.51

Corrections in Interim Returns of Live-stock.—The Census and Statistics Office advises the occurrence of certain errors in these returns as published in the *Monthly Abstract of Statistics* for June. Extracts printed on page 37 of this issue of the *Journal* must consequently be corrected as follows: Horses, 294,255 (not 299,112); sheep shorn, 23,797,130 (not 24,500,731); lambs tailed, 13,068,738 (not 13,484,243). The errors in the *Abstract* all occurred in connection with the Wellington Land District figures, these affecting the Dominion totals equally.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

SHEEP MAGGOT-FLIES AND THEIR CONTROL.

J. A. PYLE, Kenepuru Head :—

I require a little information in regard to the blow-fly: (1) What breed of sheep is most subject to fly-attack? (2) Why is it that the fly will attack sheep that are perfectly clean and not those that are dirty? (3) What is the best preventive?

The Live-stock Division :—

(1) Given suitable conditions, any breed of sheep is equally liable to blow-fly attack, and no particular breed is more subject than another. (2) While it is undeniable that a considerable amount of clean wool is blown, yet practical experience shows that the dirty sheep is usually the first to be attacked, the blow-fly laying its eggs on the soiled wool around the crutch. However, this can occur on any part of the sheep, and along the back is common. When apparently clean sheep are struck, a probable explanation is the presence of moisture in wool, such as might happen after rain. Climatic conditions giving rise to even slight irritation of the skin on the back will attract the fly. It is also known that sheep in sheltered valleys are more liable to attack than those in high, exposed country. (3) Prevention begins in removal of breeding-places of the blow-fly; dead carcasses must be destroyed by burning or burial, and offal, &c., must not be left lying about. Sheep must be kept clean and well dagged. Dressing of cuts at shearing-time is necessary. Dipping, of course, is the best method of prevention, although this cannot be said to act as a complete preventive. The powder arsenical dip gives the best results, as the ingredients are held longer in the fleece. The dip should be absolutely clean. Dipping sheep in a dirty dip predisposes to the trouble. A good deal of work has been done by the Department of Agriculture towards establishing an effective insect parasite of sheep maggot-flies in New Zealand, and, while it may be too much to hope for complete protection from this source, such may in time considerably lessen the pest and the damage it causes.

ALMOND VARIETIES FOR CROSS-POLLINIZATION.

"AMATEUR," Tolaga Bay :—

Please advise me as to the best variety of almond-tree to plant, and also give me the name of a pink-flowering kind. I have a large Lewelling almond, and am told it will not bear unless a pink-flowering variety is planted near. It is covered in white blossoms every season, but the fruit just drops off, only a few maturing. I have two small Jordans in the same orchard not yet bearing.

The Horticulture Division :—

Experience with almond-trees in this country is somewhat limited, but the most promising varieties are Nonpareil, I.X.L., and Ne Plus Ultra. The pink-flowered kind you refer to is probably *Amygdalus communis*, a very popular species, but I.X.L. and Ne Plus Ultra flower at the same period as Lewelling, and it is most probable that one at least would be effective as a cross-pollinizer.

RIDDING TURKEYS OF WORMS.

"PUZZLED," Pihama :—

I should be grateful if you would inform me of the right remedy to use to get rid of worms in turkeys.

The Live-stock Division :—

We would advise you to try the following treatment : Starve the birds for a day, and then give them a dose of Epsom salts (about one 1 oz. packet for every ten birds) dissolved in the water with which the mash is mixed, adding also to the mash some sulphur (about the same amount as the salts) and a teaspoonful of pure spirit of turpentine for every four birds, the whole to be mixed with the ingredients before they are moistened. Repeat, if necessary, in a week's time.

TOP-DRESSING OF DAIRY PASTURE.

"SUBSCRIBER," Woodville :—

I am dairying on 36 acres of land. This past season I carried seventeen cows, and they will return approximately 5,500 lb. butterfat. The same farm would only carry eight cows five years ago before liming and top-dressing with super. I have followed the Department's advice of liming in the autumn and top-dressing in the spring with super. What I want to know is this : (1) Will the lime and super burn up or exhaust the nitrogen and other plant-foods in the soil after a few years of boosted production ? (2) Will the luxuriant growth of clovers and the double carrying-capacity of the land replace the nitrogen, &c., by way of nitrogen from the air and the droppings from the cows ? (3) If super is applied to land after liming, does the land become sour after a number of years continuous treatment ? (4) Would it be better to apply a basic super to the soil instead of liming with carbonate of lime and top-dressing with super later ? (5) Should the action of lime be upon the soil or upon the super first, as in the case of manufacturing basic super ? I ask these questions because I am being repeatedly told that in a few years my farm will go back to a sour exhausted condition.

The Fields Division :—

(1) and (2) Continuation of your practice, as described, instead of depleting the soil will lead to an increase of available supplies of those plant-food substances. The supply of total potash will be reduced, but this will be to such a slight extent as to be not worth consideration unless your soil is very abnormal in potash content. (3) The answer is in the negative. (4) and (5) As a general rule, the application to the land separately of lime and superphosphate may be taken to be the better practice. An outstanding virtue of super lies in the fact that its supply of phosphate is in a water-soluble form. This means not only that super is relatively very ready in its action, but also that valuable phosphate is distributed throughout the soil in a much more thorough manner than could be achieved by any other means. In basic super the phosphate is not water-soluble. To sum up, continuation of the practices you describe will lead to increased rather than to decreased productiveness of your farm. Regular and systematic use of the combined chain and tripod harrows on the pastures will materially assist in this process of improvement.

REMOVING WOOL FROM SHEEP-SKINS.

C. WAITES, Queenstown :—

I should like to know the best way to take wool off old dried sheep-skins.

The Live-stock Division :—

Considerable work is entailed in removing wool from skins, especially under your circumstances, and it would seem advisable to sell the skins with the wool on them. The following recipe, however, is sometimes used for removal : Dissolve 1 lb. caustic soda in 2 gallons water ; add sufficient slaked lime to make a good thick paste ; apply this with a brush to the flesh side of the skin ; fold skin over lengthwise, wool side out ; leave until next day ; then pull wool off the skin. One must wear leather gloves when painting on the paste, also when pulling the wool off the skin, so as to avoid burning the hands. The skin must be thoroughly soaked in water a little while before the paste is applied, the degree of soaking depending on its dryness.

PROTECTION OF VEGETABLES FROM SMALL BIRDS.

"RUBUS," Hakaru :—

Could you give me a recipe for birdlime? If any actual lime is used, please state what kind. I want to try the birdlime for skylarks; they ruin all our early vegetables; it is impossible to keep everything covered.

The Horticulture Division :—

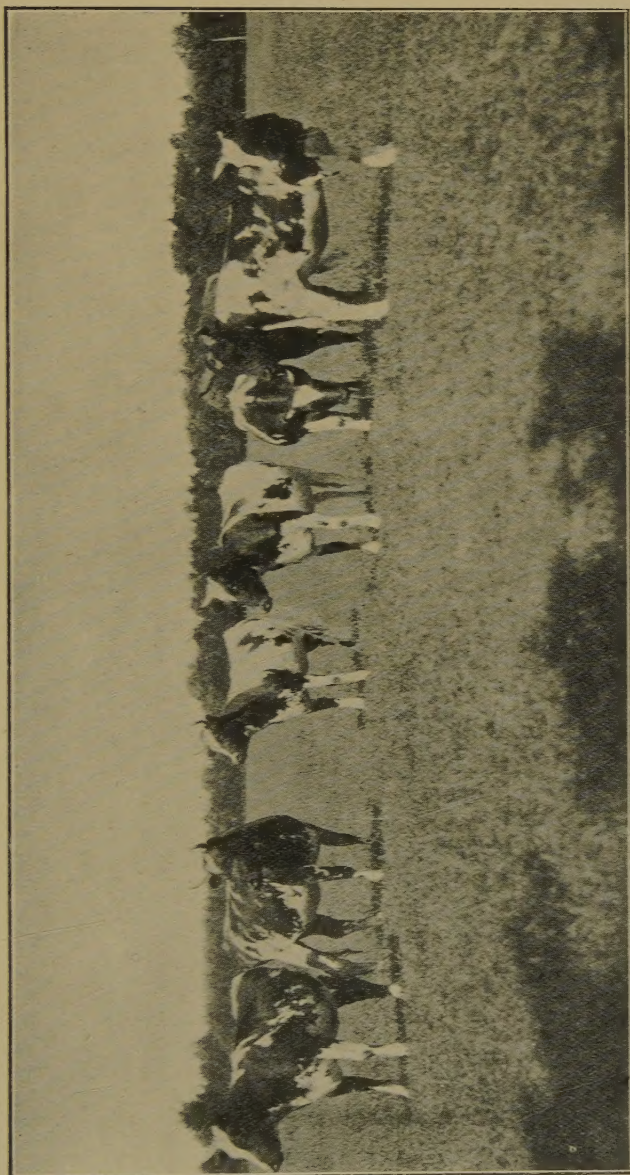
We regret not having a reliable recipe for birdlime. The Syrian birdlime is excellent, and used to be imported and sold by Mr. A. A. Corban, of Mount Lebanon Vineyards, Henderson. You might try an adhesive that is used for bandaging fruit-trees in some countries. It is composed of eight parts resin and four parts rape-seed oil melted together, or 12 oz. castor-oil and 27 oz. resin. To protect seeds from birds, many kinds may be soaked in kerosene for a few minutes before sowing, or they may be moistened only with kerosene and sprinkled with powdered red-lead, shaken up together to distribute the substance, and spread to dry before sowing. These methods are very effective. Young plants will be protected to a great extent if they are sprayed or dusted with almost any of the remedies used in fungus or insect control.

VARIETIES OF APPLES AND PEARS EXPORTED, SEASON 1928.

THE following particulars of the varieties of apples and pears exported from New Zealand in the past season have been compiled by the Horticulture Division from export certificates. The figures for apples represent 1-bushel cases, and those for pears crates consisting of three trays, each tray containing from 10 lb. to 12 lb. of fruit.

Apples.—Sturmer, 272,892; Jonathan, 218,322; Delicious, 171,018; Dunn's, 69,424; Cox's Orange, 56,551; Dougherty, 41,452; Statesman, 25,683; Cleopatra, 15,000; London Pippin, 10,561; Rome Beauty, 8,982; Ballarat, 8,048; Worcester Pearmain, 6,961; Rokewood, 6,026; Lord Wolseley, 5,943; Newtown Pippin, 5,087; Tasma, 4,866; Stayman's Winesap, 4,103; Premier, 3,584; Spitzenberg, 3,034; Pioneer, 2,446; King David, 2,350; Grannie Smith, 2,009; Salome, 1,944; Scarlet Nonpareil, 1,889; Adams Pearmain, 1,594; Alfriston, 1,549; Stark, 1,426; Gravenstein, 1,421; Willie Sharp, 1,194; Yates, 1,148; Ribston Pippin, 1,062; Shorland Queen, 816; Hoover, 783; Brownlee's Russet, 668; Edward Lippiatt, 662; Brighton, 576; Golden Pippin, 539; Parlin's Beauty, 442; McLiver's Winesap, 423; Blenheim Orange, 409; Stone Pippin, 367; Simmonds Winter, 366; Celo, 314; Frimley Beauty, 256; Tasma Pride, 241; McMahan's White, 235; Boston Russet, 219; Democrat, 132; Scarlet Pearmain, 126; McIntosh Red, 125; Commerce, 106; Baumann's Reinette, 89; Black Ben Davis, 82; Glengyle Red, 51; Grooby's Seedling, 47; Shepherd's Perfection, 33; Senator, 24; Grime's Golden, 23; Golden Delicious, 21; Rona, 20; Crofton, 20; Sharp's Late Red, 4. Total number of cases, 965,788.

Pears.—Winter Nelis, 18,808; P. Barry, 13,382; Winter Cole, 10,201; Josephine de Malines, 3,147; Beurre Bosc, 2,012; Packham's Triumph, 1,863; Doyenne du Comice, 1,133; Vicar of Winkfield, 644; Beurre Clairgeau, 468; L'Inconnue, 358; Beurre Diel, 271; Glou Morceau, 237; Conference, 130; Marie Louise, 125; Keiffer, 111; Giblin's Nelis, 99; Harrington's Victoria, 86; Elizabeth Cole, 71; Beurre d'Amanli, 70; Louise Bonne de Jersey, 50; Beurre Capiaumont, 50; Williams Bon Chretien, 49; Beurre d'Anjou, 25. Total number of crates, 53,390.



AYRSHIRE HEIFERS AT RUAKURA FARM OF INSTRUCTION.

DAIRY FACTORIES IN NEW ZEALAND, 1928.

THE following table presents the registrations of factories under the Dairy Industry Act as at 30th April last, together with the quantities of butter and cheese forwarded to grading-stores for export during the year ended 31st March, 1928, and the numbers of milk or cream suppliers to the factories:—

District.	Number of Factories.				Forwarded for Export, 1927-28.		Number of Suppliers to Factories.	
	Butter.	Cheese.	Dual Plant.	Total.	Butter.	Cheese.	Butter.	Cheese and Dual Plant.
					Tons.	Tons.		
Auckland ..	59	31	8	98	47,155	11,206	17,456	1,304
Taranaki ..	18	65	38	122	8,518	32,635	3,042	3,239
Wellington ..	19	48	8	75	8,489	11,431	4,973	1,544
Hawke's Bay ..	12	15	2	29	3,329	3,387	3,906	548
Nelson ..	7	3	1	11	1,082	459	1,152	425
Marlborough ..	3	1	4	8	642	718	695	197
Westland ..	8	2	1	11	487	38	619	42
Canterbury ..	9	14	3	26	1,738	1,901	4,756	1,884
Otago and Southland	9	77	1	87	2,037	12,427	6,981	2,896
Totals ..	144	257	66	467	73,477	74,202	43,580	12,079

Whey butter was manufactured as a side-line at eighty-one of the above cheese-factories in 1927-8, the total quantity forwarded for export being 1,117 tons. This is not included in the total amount of 73,477 tons of butter given in the table, which refers to creamery butter only.

In the 1927-8 period there were also operating in the Dominion six milk-powder factories (three whole-milk and three skim-milk plants), four casein-factories, two condensed-milk factories, and one sugar-of-milk factory.

WOOL-RABBIT FARMING.

A USEFUL little book entitled "Angora Wool Rabbits for Profit," by Arthur Sainsbury, editor of the *New Zealand Smallholder*, has recently been issued by the Brett Printing and Publishing Co., Ltd., Auckland. The book deals with the industrial aspect of the subject, and comprises sections on the breeding, farming, feeding, and housing of Angora rabbits, rabbit ailments, &c. Now that the importation and keeping of these animals has been conditionally authorized, as referred to elsewhere in this issue, the book (which is priced at 4s. 3d. posted) will doubtless find many readers.

Checking of Milk and Cream Tests at Factories.—Referring, at the National Dairy Association Conference last month, to the initiation of this work by a special officer during the past season, Mr. W. M. Singleton, Director of the Dairy Division remarked: "The work is deemed so important that we are expecting to have an additional officer appointed for this work next season. Special attention has been given to those dairy companies which had highest yields during the preceding season. It is intended to follow the work up even more assiduously. These officers will work under direct instructions from Wellington so far as the check testing is concerned. This arrangement is to safeguard the good feeling existing between factory-managers and our dairy instructors. We do not want factory-managers to get the impression that butter and cheese instructors are inspectors. Up to the present we can scarcely get the managers to realize that the check-testing officer is an inspector. One factory-manager actually requested a visit of the check tester. It appeared to be evident that the inspector would find little if anything wrong at that factory."